KINGDOM OF CAMBODIA
Ministry of Agriculture, Forests and Fisheries
GDA

PROJET D'APPUI AU DEVELOPPEMENT DE L'AGRICULTURE AU CAMBODGE

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Project SANREM
"Conservation Agriculture for Food Security in Cambodia and the Philippines"

Technical support Mission for the implementation of a Farming System Reference Monitoring Network in the province of Battambang.

Agrarian diagnosis and identification of a farming systems typology, in order to implement a reference farms network, in Battambang province – Ratanakmundul district)

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Donors: USAID-SANREM CRSP (Office of International Research, Education, and Development - **Virginia Tech Blacksburg**)

Lead Institution: North Carolina Agricultural and Technical State University - **Partners**: PADAC/GDA-RUA-AVSF.

Technical support Mission for the implementation of a Farming System reference Monitoring Network in the province of Battambang

Résumé

Le Projet d'Appui au Développement de l'Agriculture du Cambodge, PADAC, a pour objectif général de préparer une diffusion à grandes échelles des technologies SCV, en premier lieu comme outil de mise en valeur des surfaces strictement pluviales qui constitue l'essentiel de la « réserve foncière » du Cambodge et secondairement comme voie d'intensification et de diversification de la riziculture inondée, l'essentiel des surfaces cultivées par une agriculture familiale largement « condamnée » à l'autosubsistance et à la pluri-activité. Le projet SANREM prévoit une extension sur la région de Batambang.

La mission a pour objectif de partiellement accompagner et répondre aux besoins du projet avec la mise au point d'un outil permettant une meilleure adéquation des technologies proposées en fonction des types d'exploitants : un Réseau de Fermes de Référence (RFR) sur la zone de Battambang comme cela a déjà été faite en 2009 sur Kompong Cham. Cette mission vise à assurer un appui technique et méthodologique à une enquête de caractérisation des exploitations agricoles dans 2 ou 3 villages (prévu pour une vulgarisation pilote dans le district de Rattanak Mondul, province de Battambang province, l'élaboration d'une typologie régionale des exploitations agricoles et la mise en place d'un réseau de fermes de références Elle est liée à la mise en œuvre de 2 stages d'étudiants (binômes franco khmers) réalisant leur mémoire de fin d'étude dans le cadre du projet, de Mars-Avril à Août-Septembre 2010.

Summary

The PADAC project has as general objective to prepare for a large scale diffusion of CA technologies for strictly rainfed areas which constitutes the essence of the "land reserve" of Kampuchea. Secondarily, it can sustain various intensification levels and diversification/alternatives of flooded rice systems beside self-subsistence and pluri-activity (off farm). The SANREM Project schedules an extension on the area of Batambang. The mission aims partially to accompany (methodology) and train the project members and associated students trough the development for a modelling tool allowing a better adequacy between CA technologies and farmers' types. A Farming System Reference Monitoring Network will be implemented in the zone of Battambang as that already developed in 2009 in Kompong Cham. This mission provides technical and methodological support to the surveys to be done: farm characterization in 2 villages (district of Rattanak Mondul, province of Battambang).
During the mission, support has been provided to 2 training courses of students (Khmer and frencf) scheduled to implement surveys from March-April to August-September 2010.

1 Introduction

1.1 The PADAC project (Projet d'Appui au Développement de l'Agriculture du Cambodge, CIRAD/AFD/MAFP)

PADAC is a Ministry of Agriculture, Forestry and Fisheries (MAFF) project located in the General Directorate of Agriculture (GDA), and funded by the French Development Agency (AFD). It began in mid-2008 and will be funded until mid-2012. PADAC, located in GDA of MAFF, is considered a practical "think tank" for the smallholder agricultural development on the vast upland land reserves of the country. Despite these promising activities, several knowledge gaps must be tested for CA to expand in Cambodia. CA involves minimal soil disturbance, continuous retention of residue mulch on the soil surface and a diverse and rational use of crop rotations (Erenstein, et al 2008).

An effort to promote CA practices has been by the Centre de Cooperation Internationale en Recherche Agronomique pour le Développement (CIRAD, the French Agricultural Research Center for International Development), which began CA projects in 1999 in Laos and 2004 in Cambodia with funding by Agence Française de Développement (AFD) a French Development Agency. The focus of these projects has been CA research and development for smallholder upland cultivation. Technical knowledge, based on "Direct-seeding Mulch-based Cropping system" (DMC), have been transferred from Brazil and adapted to local socio-economic conditions for main crops such as corn, cassava, soybean, and upland rice. In Laos, a pilot extension network reached 2000 ha in 2008, while in Cambodia "Projet d'Appui au Développement de l'Agriculture du Cambodge" (PADAC, in English 'Project for the Development of Agriculture in Cambodia') are confident they will meet their target of 500 ha in CA by 2011.

The PADAC is also part of the recent South East Asia DMC Network (Conservation Agriculture Network in South East Asia - CANSEA, officially created in September 2009) which will coordinate different regional actions in Laos (with the National Agricultural and Forestry Research Institute), Vietnam (with the Northern Mountainous Agricultural and Forestry Science Institute and the Soils and Fertilization Research Institute (SFRI), Thailand (Kasetsart University), China-Yunnan (Yunnan Academy of Agricultural Science).

CAPS, "Conservation Agriculture Productions Systems," are tailor fitted systems approaches for successful adoption and implementation of CA to specific locations. CA is the basis of CAPS, which involves optimum integration of seed or seedling establishment methods, farm implement selection, choice of crops in rotation, germplasm suitability, mulch and fodder management, demand for produce, profitability, nutrient management, farmer preferences and skills, local government policies, credit availability, production inputs, labour, gender, and so on. CAPS are underpinned by a 'basket' of agricultural, marketing and local government policy practices or a 'toolbox' of practices that promote CA. CAPS can vary from year to year depending on product demand and crop rotation schedule. In this way, the evolution of CAPS is driven by farmers, local government, and markets. Farmers choose what the best CAPS are (Derpsch, 2008).

PADAC designed a large range of operational (i.e. mastered at all scales of application) conservation agriculture production systems with corn, cassava, soybean and upland rice as main crops which can potentially integrate secondary crops such as sesame, cowpea, sorghum, pearl millet, rice-bean, and buckwheat. Cover crops are principally from 2 fodder

species, *Brachiaria ruziziensis* (grass) and *Stylosanthes guianensis* (legumes), opening significant opportunity to close-by grain-livestock association. The design and technical assessment of CAPS was made through annual experimental systems (including experimentation, collection of plant materials, demonstration plots, and seed production) of around 50 ha. Most of this work was implemented in Kampong Cham, an important province for annual upland cash crops. CIRAD transferred coordination of this research to PADAC, in which CIRAD is a partner. PADAC selected a promising CAPS technology and has been implementing it in a pilot extension network of 100 ha with 150 households in Kampong Cham in 2009 and aims to expand to 500 ha in 2011 involving 350 households.

This technology network principally aims, on an annual basis to: (i) assess, optimize and monitor the technical-economic performances of the cropping systems and test their resilience or variance in various application conditions (i.e. initial soils fertility, farmers' skills, climate) and compare them with the conventional system; (ii) study the best way for access to production inputs such as credit, and specific relevant tools to replace those for the plowing and conventional sowing by ones focusing on CAPS e.g., specific drillers, hardy machinery imported from Brazil, sprayer and rollers; and (iii) train farmers in CAPS. All this work is built around the implementation of a contract farming process between agro-industry and young farmer groups supported by PADAC through a pilot contract signed with a large regional animal feed company targeting purchase of 10,000 tons of raw materials by 2012. Furthermore, PADAC developed trade partnerships between farmers and agro-industry processors as a primary condition to propose progressive crop diversification through various successions and rotations.

These CAPS were successfully tested in Kampong Cham. Note that these proposed CAPS can change since they are in constant evolution through real participatory technology design with farmers. For instance, we will launch some tests with rice bean (*Vigna umbellate*) a secondary crop that is also a cover crop, implemented in relay with corn. In Kampong Cham, PADAC will continue monitoring its CAPS. Similar methodology is implemented by PADAC in its pilot extension network in Kampong Cham province where the developed CAPS may be different due to different marketing opportunities and also differences in soil type. Hence, during this study, CAPS' resilience will be tested in 2 regions with contrasting biophysical and socio-economic conditions.

PADAC activities are around 3 main topics:

- 1er axis : the bases for Creation-Diffusion-training
- 2ème axis : Training, Animation & network
- 3ème axis : Preparation of an extension programme at large scale for CA

As a real change of paradigme, there is many problems of CA adoption. Derpsch (2008), reported many obstacles and factors that hinder CA adoption in small farms. They are government subsidies, lack of machinery or techniques adapted to the conditions, lack of transfer of technology to the farmers and technicians, lack of institutional support, a resilient mindset among farmers, communal grazing which removes the important soil cover, too little research and development, inadequate extension efforts and funding shortages allocated for small farms. In addition, it is hard to reach a large number of small farmers in remote areas; individual assistance over a period of time is necessary when working with small-scale subsistence farmers. Furthermore, no technology will be adopted unless it is economically

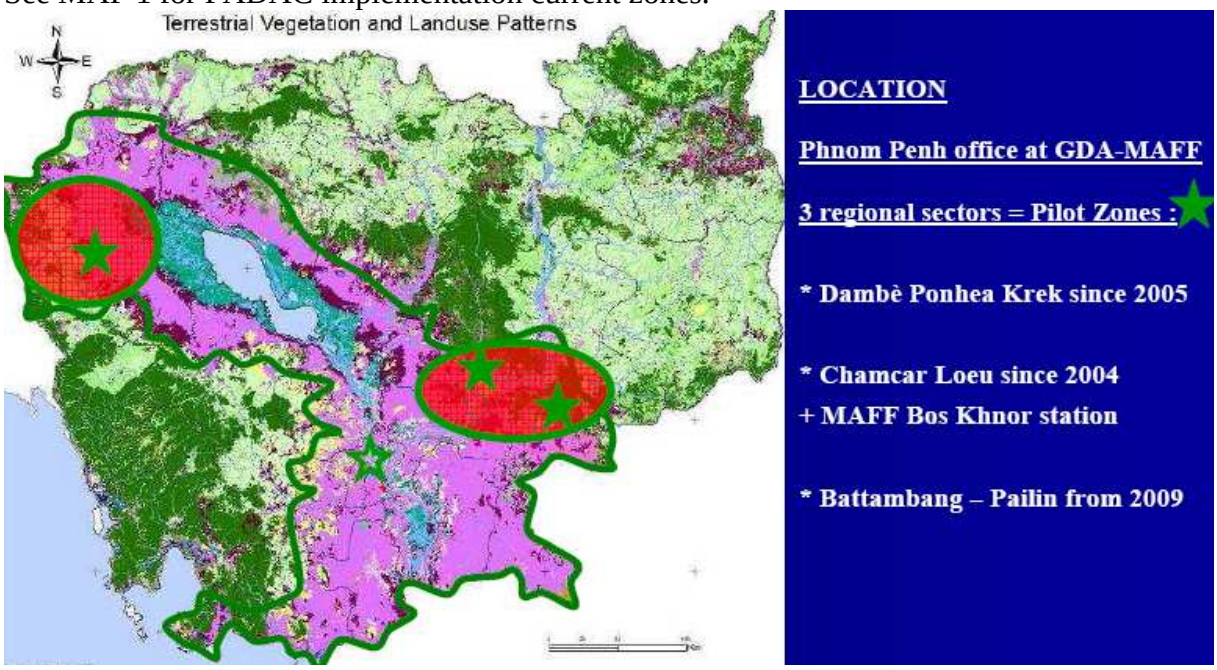
viable and socially acceptable to the farmers and community at large. Profitability of CAPS is at the heart of the adoption decisions of farmers.

The hypothesis will be tested by the following research objectives: those in bold concerns the mission:

1. To assess soil quality and measure crop yield and biomass from conservation agriculture production systems and compare them with soil quality and crop yield and biomass from conventional plow-based systems in Cambodia and the Philippines
2. **To identify field- and farm-level CAPS that will minimize smallholder costs and risks while maximizing benefits and adoption in Cambodia** and the Philippines
3. **To pinpoint gendered limitations and advantages that can promote adoption of CAPS**, and determine if CAPS will increase labor burden on women in Cambodia and the Philippines
4. To quantify the effectiveness of SANREM-supported farmer groups in Cambodia and the Philippines in training knowledge leaders, in being knowledge transmission points, and in facilitating network connections leading to widespread adoption of CAPS; and to find out whether a proposed micro-credit approach, and a method to facilitate access for mechanized direct seed drilling and spraying will be successful in promoting adoption of conservation agriculture in Cambodia.

d. Methods to be used in carrying out the proposed project, including their feasibility

See MAP 1 for PADAC implementation current zones.



Map 1: The PADAC zones

PADAC principally aims to design, promote and assess DMC as a vector of a sustainable development of annual crops cultivation on Cambodian upland areas; activities related to this principal objective are conducted in the two major Cambodian provinces for upland crops productions:

- Kampong Cham, in 2 zones, Chamcar Loeu and Dambè - Ponhea Krek (since 2004)
- Battambang, on the western districts of Rattanak Mondul and Kamrieng (only since 2008)

1.2 The SANREM project

SANREM objectives
PADAC and SANREM will, on a smaller scale (200 ha - 150 households), replicate in Battambang province the approach used in Kampong Cham in eastern Cambodia. It will be associated to a training course on the use of the software « OLYMPE» for officials from MAFF, NGO agents, teachers and students from RUA.

The Sustainable Agriculture and Natural Resources Management Collaborative Research Support Program (SANREM CRSP) is an initiative of USAID. Its main purpose is to foster Sustainable Agriculture (SA) and Natural Resource Management (NRM) through collaborative research between U.S. and developing country institutions for their mutual benefit by improving their abilities to develop and implement socially, economically, and environmentally sound agricultural production and NRM practices. The objective of the SANREM CRSP is to support SA & NRM decision-makers in developing countries by providing access to appropriate data, information, tools and methods of analysis, and by enhancing their capacity to make better decisions and thereby improve livelihoods and the sustainability of natural resources. The SANREM CRSP strives to develop and implement a replicable approach to SA and NRM that will help: 1) enhance stakeholder livelihoods; 2) promote sustainable agriculture and natural resource management systems; 3) increase the involvement of women in SA and NRM decision making; and 4) foster biodiversity.

SANREM priority areas of inquiry include:

- **Technology Integration:** Technologies needed by stakeholders and decision-makers to promote SA&NRM practices (i.e., biotechnology, GIS, decision support tools, etc.).
- **Governance:** Policies and institutional arrangements enabling civil society to better manage natural resources.
- **Economic Policy and Enterprise Development:** Supporting sustainable SA & NRM practices that develop niche markets, and are eco-friendly and competitive.
- **Social and Institutional Capacity Building:** Training and policies promoting improved SA & NRM leadership, NGO technology transfer, and increased civil society and government synergy.
- **Biodiversity Conservation and Environmental Services:** Investigating synergistic relationships between production, biodiversity, and livelihoods.
- **Systems Linkages:** The integrated SANREM CRSP systems approach demonstrates how linkages between gender, biophysical, technology, governance, economic, social, environmental, and globalization factors achieve sustainable development.
- **Globalization, Vulnerability, and Risk:** SA & NRM best practices to manage globalization and address risk and vulnerability caused by HIV/AIDS, food insecurity

The partners of the **SANREM CRSP** project (Sustainable Agriculture and Natural Resources Management Collaborative Research Support Program – Virginia Tech) ate the following: **PADAC/GDA**: : Project for the Development of Agriculture in Cambodia (co managed by

the CIRAD and the Ministry of Agriculture, Forestry and Fisheries of Cambodia, MAFF); **GDA**: General Directorate of Agriculture (MAFF), **RUA** : Royal University of Agriculture in Cambodia, **AVSF** : « Agronomes et Vétérinaires sans Frontières »
The SANREM team is from the USA: North Carolina Agricultural and Technical State University (NCA&T) and the United States Department of Agriculture-Natural Resources Conservation Service-East National Technology Support Center (NRCS); from Cambodia: "Projet d'Appui au Développement de l'Agriculture du Cambodge" (PADAC), and its CIRAD's technical assistants, "Agronome, Véterinaire Sans Frontière" (AVSF) and the Royal University of Agriculture, Phnom Pehn (RUA); and from the Philippines: University of the Philippines at Los Baños (UPLB) and Landcare Foundation Philippines, Incorporated (LFPI

The SANREM Methodology

***Objective 2:* Identify field- and farm-level CAPS that will minimize smallholder costs and risks while maximizing benefits and adoption in Cambodia..**

An economic impact analysis evaluates the economic effects of a particular event or activity on a region, and predicts changes on the level and makeup of economic output of that region. The local or regional economic impact of the project is the economic output crop yields, smallholder income, input requirements, employment and the other effects that can be attributed directly or indirectly to the project. The major objectives of the socioeconomic and economic impacts evaluation component of the proposed project are: (i) To conduct an initial socioeconomic and biophysical baseline survey to collect data on baseline conditions for use in the impact analyses, and (ii) to conduct socioeconomic and economic impact analyses.

Initial socioeconomic and biophysical baseline survey: Surveys and interviews are two excellent methods for identifying priority social and economic goals of stakeholders. Conducting a baseline survey of smallholders can guide the specific project goals. Such survey can also provide the project team with a foundation for assessments during the project evaluation period. A survey questionnaire that elicits smallholders' production and cultural practices, output information activities, marketing activities, demographic as well as economic and socioeconomic information will be developed. Question on the production and cultural practices will include crops/livestock raised, rotation type, types of and levels of input bundles, implements employed and so on while the output information includes crop yields and numbers of livestock in different stages of production. The demographic and socioeconomic information will include gender and age distribution of farm employment, land ownership by gender and age, and smallholder's education level. The economic questions will include, but are not limited to, smallholder's income, farm assets. The questionnaire will be augmented by using a review of pertinent academic and private research results, the personal and professional experience of the project team, and by surveying focus groups. The research team has hands-on experience on most of the needs of the farmers ranging from economic, management, production techniques, marketing (both domestic and international), and environmental conservation issues. Similar information will be collected at the end of the project to determine changes in behavior especially the smallholders' adoption rates for input use and other practices. Changes in variables such as smallholders' income, gender and age distribution of farm employment, and ownership by gender and age will be reported to provide to serve as project's assessment indicators.

In Battambang, Cambodia, about 200 households covering 200 ha (about 1 ha per farm) will be practicing CAPS. The same farms/households sub-samples in objective 1 for both countries will be used in this objective. Women farmer volunteers will be intentionally chosen with a goal of 50% women and 50% men participation. Every year, a record will be

kept of the precise description of all farm activities, crop performance like yield; and input costs like labor, seeds, fuel, machinery, fertilizer, and herbicide. In Cambodia, these records will be collected from 15 farms within the FG-conservation agriculture network and 15 farms in the same area which are not part of the network and practice traditional farming system based on the plow.

The suggested total number of farm to be monitored in the Farming System Reference Monitoring Network (FSRMN) is 30 according to PADAC: 15 within the project and 15 outside the project.

Objective 3: ***Pinpoint gendered limitations and advantages that can promote adoption of CAPS, and determine if CAPS will increase labor burden on women in Cambodia and the Philippines***

Gender analysis involves knowing what, where, when and how men and women perform their agricultural or income generating tasks, domestic tasks and community activities. Included also are the analysis of their access to and control of resources. The methodology will involve the participation of all team members, to expose everyone to the importance of gender analysis as a tool for user-friendly and equitable CAPS development.

Gender analysis will provide a systematic effort to document and assess the participation of women and men in the sustainability of CAPS. During the initial stage of project implementation, at the baseline survey stage, the team will conduct a participatory rapid rural appraisal which will include activities on gender analysis and will be integrated

The structured household survey will be used to generate baseline information about the farming households and establish patterns of gender division of labor by cropping season. On the other hand, the Key Informant Interview will provide significant insights on the gendered knowledge of agricultural practices (historical antecedents) and its changing patterns, and the problems encountered. Focused group discussion with a number of farmers will provide valuable information about existing farming systems and CAPS and other related issues. Random Instant Sample measurement will be used to determine time use or time allocation of women and men in CAPS.

The decision to adopt an innovation is dichotomous so an individual may choose to either adopt or not adopt as earlier stated. This is a binary choice model involving the estimation of the probability of adoption of a given practice as a function of explanatory variables such as gender, age, education, income, and others that will be collected in the survey. Sets of hypotheses of smallholder's characteristics-production practices, gender, income, and socioeconomic status on adoption rates will be tested. In addition, in Cambodia, collected data (mean and variance of the economic performances) will be entered in "Olympe" a decision support software to improve farmer's or groups of farmers' understanding of their own situation and their socio-economic context and can be used for both individual and collective scales. (Olympe, 2007). Olympe was jointly developed by l'institut national de la Recherche Agronomique (INRA), IAMM and CIRAD. Scenarios (e.g. based on different hypotheses on inputs, labour costs and products' prices combined with yields evolution) can be built in Olympe to test resilience of CAPS proposals.

SANREM works on contract farming development between agro-industries and farmer groups/organizations; this kind of pilot experience must show out that it is more interesting for large private investment to focus on processing farmers' products instead of trying to integrate primary productions within estates development which is costly and complicated involving land conflict and negative image. SANREM will clearly advocate for an

association between CAPS and pro-poor policy through support of small-medium farming, which doesn't exclude larger family based farms likely necessary for an accelerated scaling up in the future

Expected outcomes of the activity

In Cambodia, this project will extend conservation agriculture technology to 200 families in two years for a total coverage of 200 ha. This is an exciting 'tangible real help' to these families and a milestone in terms of conservation agriculture adoption in western Cambodia. And when combined with the PADAC project in eastern Cambodia (Kampong Cham), and the SANREM research to be conducted in the Philippines, this project has far reaching potential for the rapid expansion of conservation agriculture in Southeast Asia (Extension). Furthermore, both biophysical and socioeconomic research is being conducted in the midst of the expansion (Research), and a course on conservation agriculture developed to be taught in three universities (Teaching). In the Philippines, the CAPS 'HARD test' can be completed. Proposals for funding the 'SOFT test' will be developed and submitted for funding. LFPI can facilitate bank loans for CAPS practitioners and also import and fabricate machinery for CAPS expansion.
It is anticipated that labor burdens for women, men, and children will decrease because of CAPS, and soil quality will rapidly improve. Furthermore, other production inputs will be reduced like machinery wear and tear and fuel costs for tillage. Hence, it is highly probable that this project will increase profitability and promote sustainability and empower women

2 The demand.

2.1 The objectives of the mission

The objectives of the mission are the following:

- Formalization and test of the different types of questionnaires (discussion guide with the resources people, light and depth surveys, exploratory survey and restitution séances…) on the farming systems
- The sampling plan of the farms surveyed and the estimation of the representativeness of the sample
- The data analysis methodology (simple statistics on Excel sheets) in order to identify an operational and dynamic typology of farming systems
- The rapid study of the main sectors and trading networks
- The global characterization of the socio economic factors which could have impacts on the (1) farmers' decision-making process and (2) on their capacity for innovation
- The methodology for the identification and the implementation of a typology and of a references farms network with selection of the representative farms
- The modeling of the references farms network with the OLYMPE software

A short example of 3 farmers of the area, already modelled on Olympe, will be presented to illustrate the approach.

2.2 Activities

A baseline survey in 2 villages (targeted for pilot extension) in Rattanak Mondul district, Battambang province, will be conducted to characterize the villages' agrarian farming situation, cropping and livestock systems, off-farm activities, and markets. This survey will last about 6 months and will be carried out in Cambodia by two students (from Sup-agro-IRC, Montpellier - France & RUA, Phnom Penh - Cambodia).

Based on this survey, a "farming system reference monitoring network" will be implemented with the following objectives:

- identification of farmers' strategies in a rapidly changing environment (in preparation for the adoption of DMC technologies);
- Understanding of the farmers' decision-making process and their capacity for innovation;
- Economic assessment of DMC adoption at farming system and regional scale

The use of a software called « OLYMPE[1] » will enable the modelling of farming systems in order to characterise them, to identify typologies (and potentially recommendations domains for innovation transfer) and allow prospective analysis according to price, yields evolution etc…This software, associated with classical farming systems surveys enable several possibilities for analysis:

- to test the economic impact of a technical choice (of a particular rice cropping systems for instance) for different types of farms
- to compare economic results in various farm environment of a technical choice (or a technical pathway…)
- to identify farmers possibilities and potential strategies according to technical alternatives
- to calculate externalities , positive or negative, on the environment
- to test the robustness (resilience) of a technical choice according to climatic or economical uncertainties
- to assess risks
- to do a prospective analysis according to climatic events or prices volatility.

The mission aims at providing a technical and methodological support to the realization of this survey, which will be carried out from April to September 2010. It will be associated to a training course on the use of the software « OLYMPE» for officials from MAFF, NGO agents, teachers and students from RUA…

[1] Olympe is a decision support software to improve farmer's or groups of farmers' understanding of their own situation and their socio-economic context. It can be used for both individual and collective scales. Olympe is a free software developed by INRA, CIRAD and IAMM (France).

2.3 Expected results

The expected results of the mission are presented as follow:

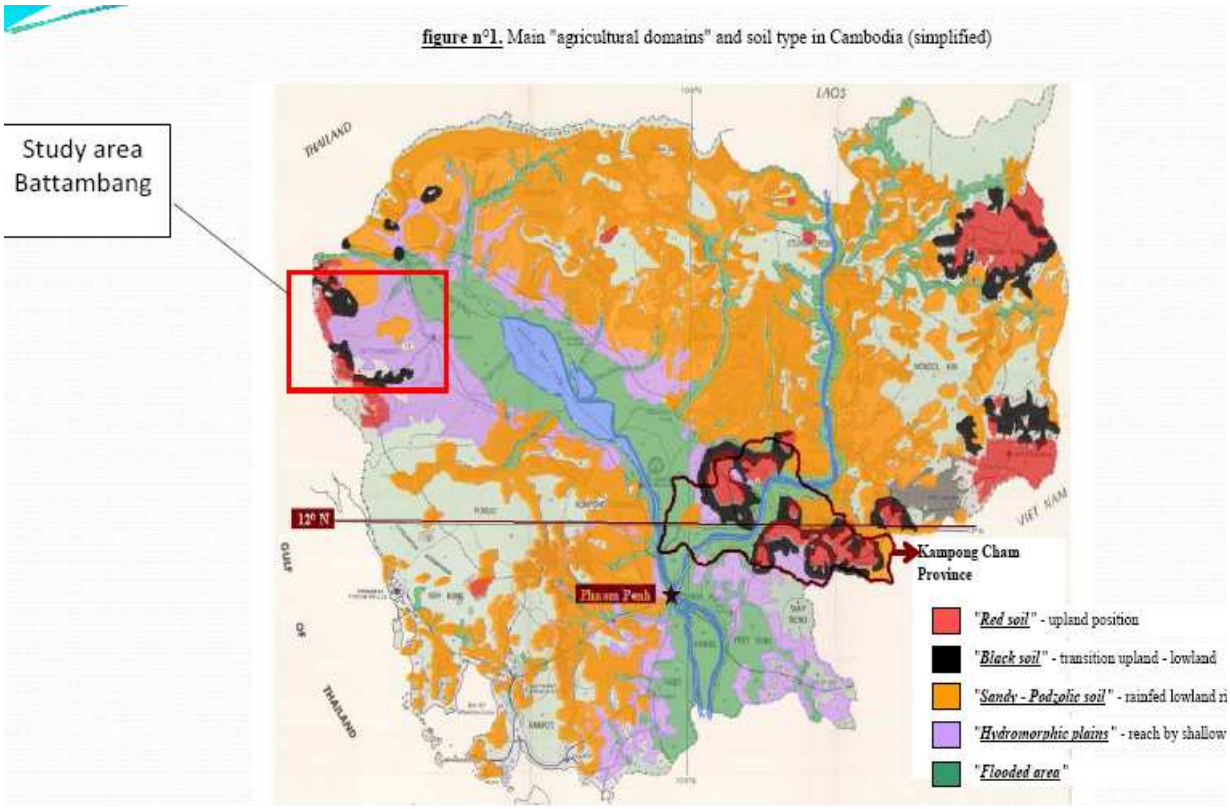
- Work plan for the agro-socio-economic diagnosis realized by the students
- Interviews guides and questionnaires for the different stages and the different objects of the diagnosis, including gender issues raised by SANREM as part of the global methodology
- Methodological guide for (1) the implementation of the references farms network and (2) their economic modeling
- Redaction of a final report in English (5 copies) which have to be sent to the project during the 30 days following the end of the mission

3 The study area: Battambang province

Until the late 1990's, Battambang province was one of the two last strongholds of the Khmer Rouge guerrillas. Battambang presents a specific agrarian situation because it has a larger farm size of 5-10 ha partly because of a land deal with Khmer Rouge soldiers prior to their surrender and also because of Battambang's climatic and edaphic features that allow the fomentation of richer and larger farm holdings. There have virtually always been larger farms in this region, and this feature was well-documented during the French Protectorate and Colonial periods over a century ago. Due to the recent post-war situation, and with many men in Battambang migrating for seasonal or permanent employment to Thailand, this region presents an unusual high rate of single women's households. With the majority of smallholders managing small-medium upland farms having easy access to Thai markets, Battambang became one of the most dynamic regions for annual crops production (MAFF, 2008).

Therefore, this region can be considered as a pilot "laboratory" for Cambodia to demonstrate the economic efficiency of giving land access for family-based agriculture. When equipped with proper technologies and sound farmers' organizations family-based agriculture will allow better access to production inputs and improved connection to market (post harvest, storage capacity, production contracts). Since 2000, because of the strong Thai market demand, annual cash crops have been profitably grown in the province. In Battambang, all upland cropping systems were based on 'contractor' disc plowing which can cause a rapid decline of soil fertility linked to induced organic matter mineralization and soil erosion. Furthermore, plowing increased production costs, due to increased weed pressure which led to more weeding labour, and mobilization of children and women in poor households.

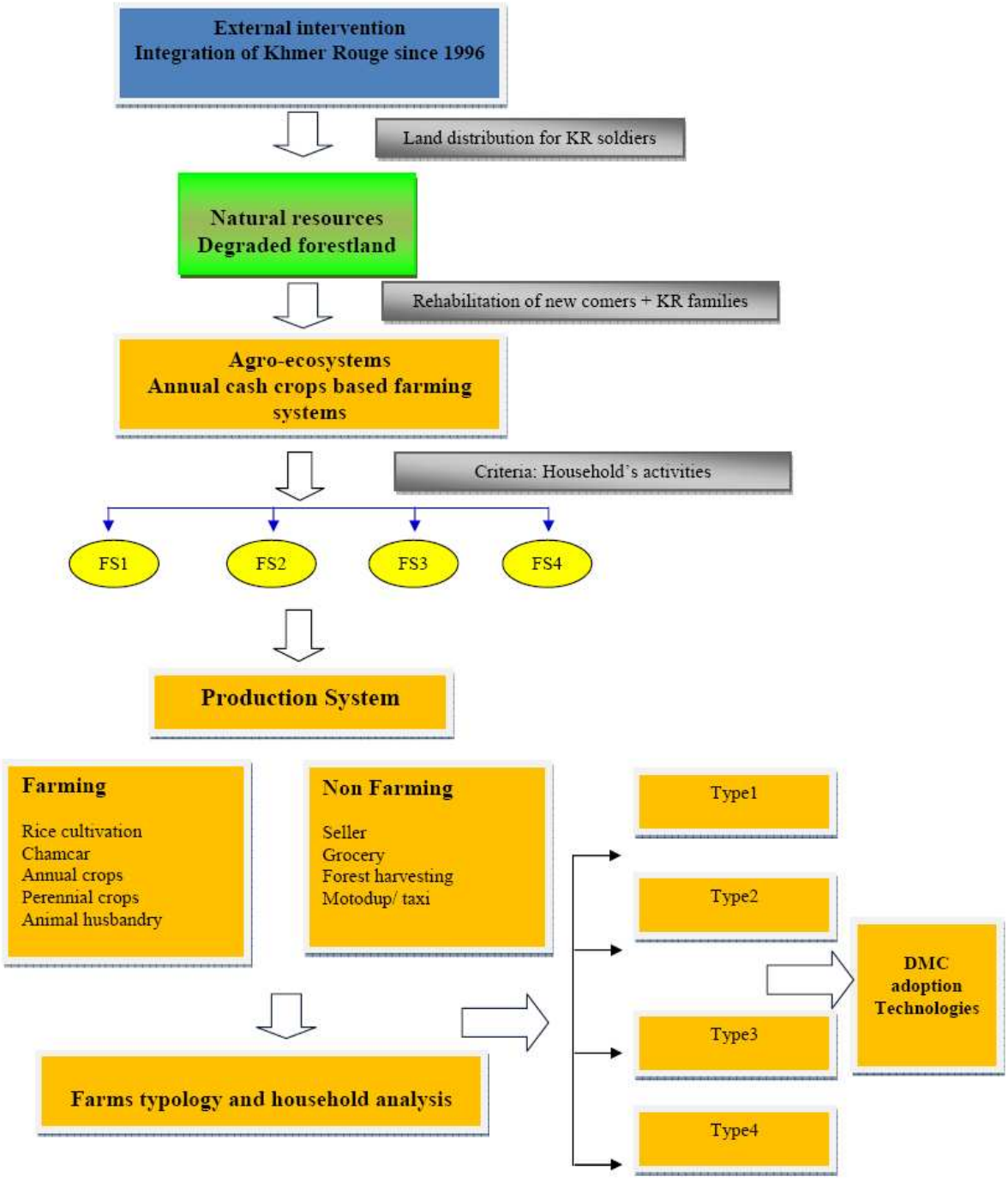
The 2 selected vilagews are: Boribo and Pich Changva villages see map n° 2



Map n° 2

Village interview during the mission

Figure 1 : farms typology and historical evolution



Village of Boribo

Mungbean crop on black soil

Upland slash and burn crops on hills

Village survey

Presentation of the pre typology

Agroforestry systems based on fruits

Sesame crop

Village of Pich Changva

Mil crop as a “pump”

housing in pioneer zones

Fruit plantation

Dragon fruit plantation

Village survey

Presentation of the pre typology

4 The activities

The mission of support was carried out by the author from 14th to 29 th of May, 2010 with the installation of all tools and surveys necessary to carry out a network of farms of references in the province of Battambang through the methodological follow-up of 2 students (1 binomial free-Kampuchean) and the training of 15 people to the software dedicated to the simulation of the farms. The software is called "Olympe". PADAC reinforces the activities of pilot development for agricultural diversification mobilizing the techniques of Conservation Agriculture (CA) on the main cultivated agro-ecosystems of Cambodia. It opens the new ground of Battambang in 2010. This mission aims at ensuring a technical and methodological support for the farming system survey (farm characterization, the development of a regional and operational farms typology of the farms and the installation of a Farming System reference monitoring network (FSRMN) of in the province of Battambang.

What is the relevance of farming system modelling in a FSRMN for PADAC/SANREM ?
A model has two main roles:

- a figurative role of representation of systems (the functioning)
- a demonstrative role (possibilities and strategies).: economic evaluation of farming and non farming activities and income generation over a period of 10 years.

The objectives of modelling are the following:

- to assess impact of farmers decisions.
- to provide orientations for policy makers by testing potential scenarios.
- To take into account individual vs collective decisions and constraints (water management for instance)

The global "farming system approach" methodology is the following;

Use of a systemic approach:
Definition of the various ***sub-systems***: cropping and live stock systems as well as transformation system. The farming system include the livelihood and takes into account family off-farm income as well as family expenses. Therefore we will later on define what we define as "income" and "balance".

FS characterization :
- Exploratory survey (ES),
- farming systems survey (FSS) :
    - Farming system evolution: trajectories
    - Farming systems strategies: strategic choices and tactical decisions

Farming system typology

- operational and representative typology

Next step after FS characterisation and typology
- Hypothesis on farmers situation
- On-farm-trial and demonstration plots programme if necessary,
- Linkages with commodity systems and markets and context analysis.

Farming system modelling and monitoring with a FSRMN for Prospective analysis
- selection of a small number of representative farms to be modelled
- Monitoring FS evolution and impact (farming system network of reference),
- Comparison analysis,
- Prospective analysis: construction of scenarios

The mission brought its support on the following points:

- the formalization and the test of the various types of questionnaires (guide of discussion with the "resource" people, preliminary light surveys, in-depth exploratory surveys and meetings of restitution…) on selected farms.
- the sampling of farms. Village sampling has been preliminary done by PADAC.
- 2 types of questionnaire will be used according to a well known methodology already used in Kampuchea in 2004 (Project hévéaculture AFD), in Indonesia, 2005 (ICRAF), Thailand, 2006 (ICRAF) and Madagascar, 2007-2010 (projects AFD BV lake and BVPI) : a village survey and a farming system survey.
- to which will be added a specific questionnaire on gender issues

The surveys and questionnaires:

2 steps for each village:

- a "village" survey with an adapted questionnaire (see annex 4) with the local community allowing general or collective data and information acquisition :1 day
- a village land use visit with discussions with key informants : identification of agro-ecological units. 2 villages will be surveyed.

- a "focus group" discussion , according to SANRAM methodology, 1 day. 2 villages will be surveyed.

- a classical "farming system survey" with a questionnaire (farm structure, cost benefit and main activities), adapted to be used with the software Olympe, already tested and validated in 2009 in Kompong Cham area. If necessary, the questionnaire could be adapted to take into account the local specificity (done during the pre survey with the consultant). 45 to 60 farms will be surveyed in the 2 villages.

- a specific questionnaire including gender issues as requested by SANREM methodology, called "Technology Networks and Gendered Knowledge Questionnaire Components for the SANREM baseline survey". The number of farms to be surveyed will take into account the typology (25 to 30 farms).

Questionnaires will be completed at the end of the mission between the PADAC team, the students and the consultant.

The village survey will provide information on history, global trends, dynamics and current situation. Il will as well provide all information common to all famers leading to a lighter farming system survey in order to optimize time. Most of the information is qualitative and will be included in the global agrarian anlysis.

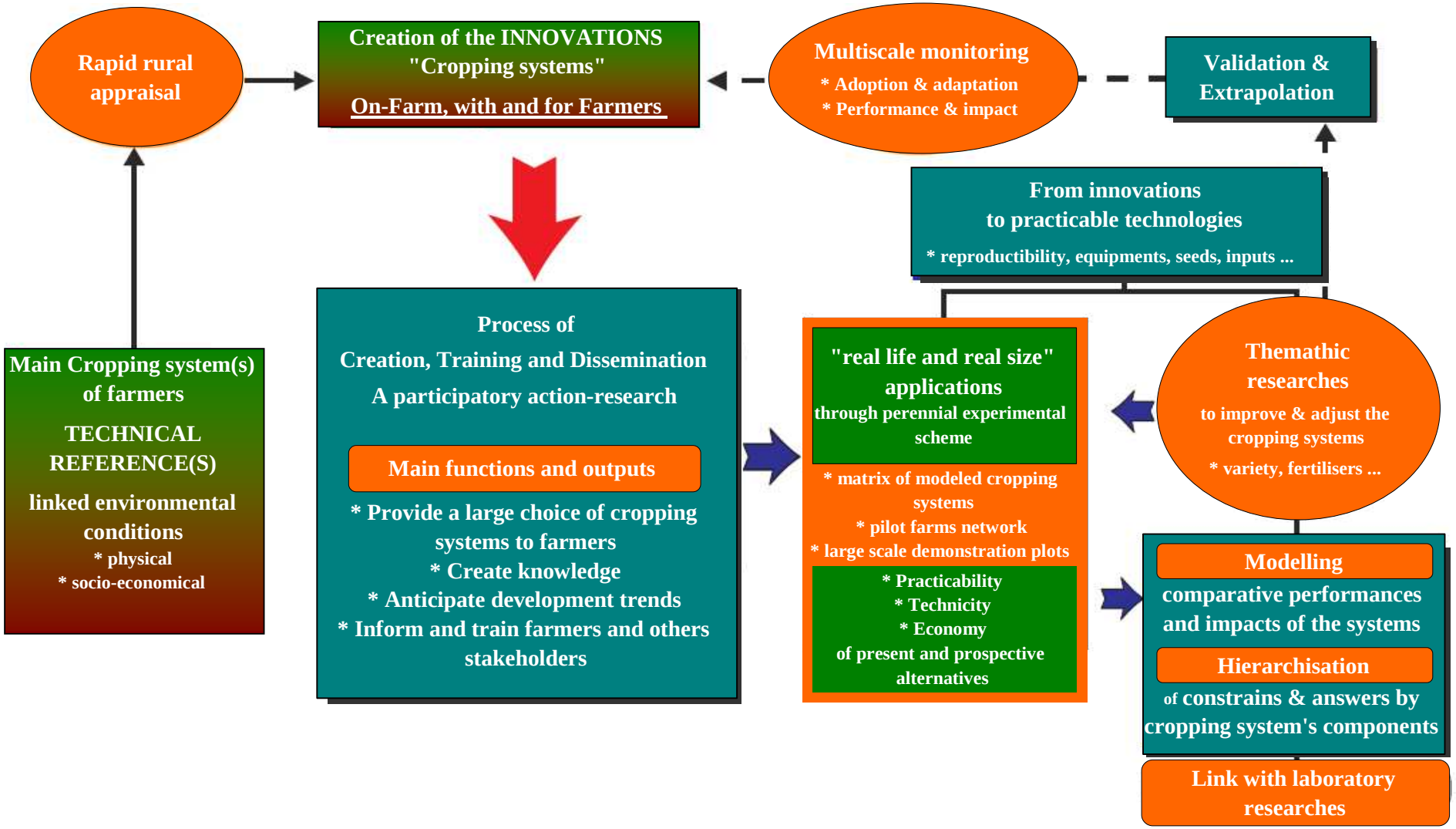
The quantitative data obtained during the focus group survey will be processed with Excel. The qualitative data will be presented in tables per topic and gender.

The farming system survey data will be processed on Excel with simple statistical analysis with the objective to constitute an operational and dynamic farms typology. It is requested from the "students to provide an Excel table with all data on farms allowing an analysis in dynamic table cross. A particular Excel table could be made by the student for the detailed treatment. An previous example of data processing was given (case study of Méduline Terrier in 2008 with the lake Alaotra, Madagascar, of Solenn Davadic and Fabien Thomas in 2009 in Kompong Cham). Following this data analysis, a farming system typology will be proposed according to the principal criteria of differentiation: a pre-typology will be carried out at the end of the mission that will be confirmed or possibly modified according to the result of the investigations.

The "Technology Networks and Gendered Knowledge" data will be processed with Excel.

Such approach is included in the global PADAC approach: see figure 2

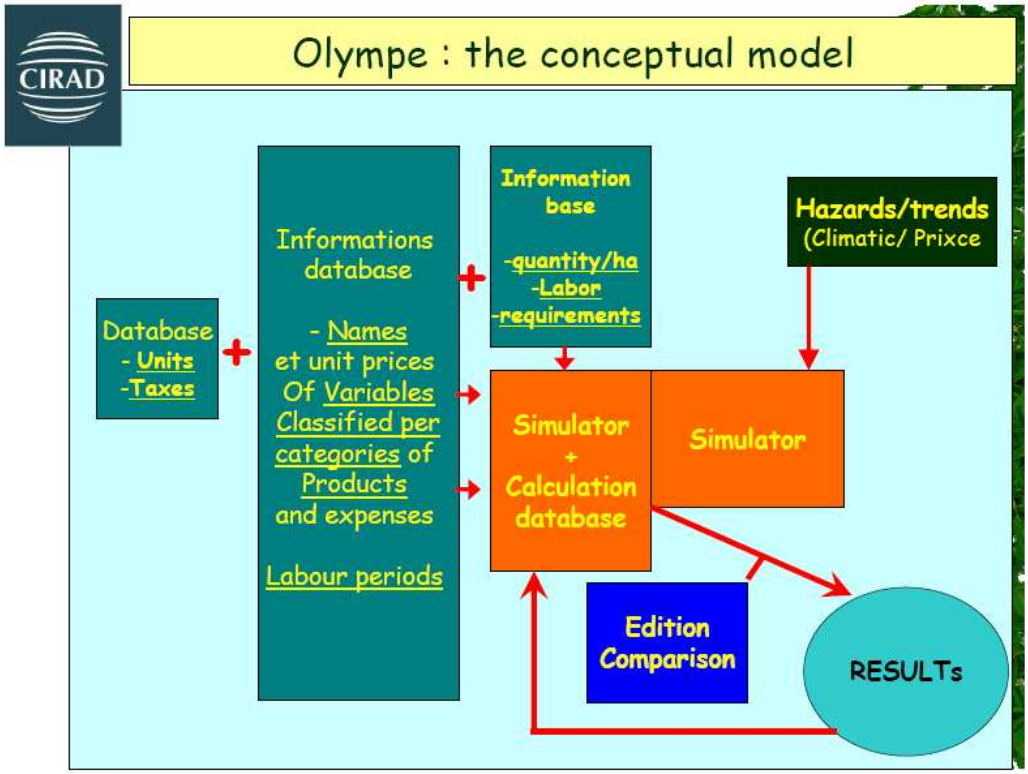
figure n°2. Action-research and development, On-farm, With and For Farmers in the PADAC project



The village survey will enable to determine the access to markets, credit and the principal actors" networks in terms of diffusion and innovations processes. The characterization of the local context and the socio-economic factors having an impact on the producers is important to contextualize the farming systems data. Following the farming system survey, an operational typology will be identified. A selection of the most representative farms among that surveyed will be proposed by the students and then validated by the project for the FSRMN. These farms will be modelled with Olympe.

This modelling will be made by the students of each group, then re-examined and validated by the author and the members of the project at the end of the training course. The awaited results were the following: - scheme of work for the agro-socio-economic diagnosis carried out by the trainees - guide talks and questionnaires for the various phases and the various objects of the diagnosis - methodological guide for (1) the installation of the network of farms of references and (2) their technico-economic modelling - drafting of a final report in French.

Figure 3: The Olympe conceptual model



5 Methodology for the agrarian diagnosis for the region of Battambang

The **methodology** is based on the following stages that create a framework for implementation:

Diagnosis
---> A preliminary diagnosis based on the study of all available information (bibliography, data collections, key-informants), and an exploratory survey.

Pre –typology identification and associated hypotheses
Survey of the characteristics of the farming system
---> To understand the constraints, opportunities, income and labour productivity of each cropping system and farm activities. The data analysis should provide an operational typology and a clear identification of constraints and opportunities.

Identification of a typology

Selection of the farms to be included in the Farming System Reference Monitoring Network (FSRMN)
Monitoring farming systems and prospective analysis
---> Implementation of a "farming systems monitoring network of reference" in order to monitor technical change and the adoption of innovations, and to assess their impact and externalities at the scale of the farming system and at the regional scale.

Analysis and re-assessment of the research program
---> Feedback analysis with farmers, extension agents and research institutions and the re-assessment of the on-farm trial in a constantly ongoing process of R-D

An agronomic approach comprising of on-farm experimentation linked with a socio-economic approach (farming systems analysis, typology, etc.) provides suitable technical pathways or improved cropping systems for farmers and also ensures adequate conditions for the adoption and appropriation (of innovations) by farmers as a function of the different situations encountered in terms of further rubber development.

Criterias for the pre typology:

Potential criteria could be the following (without priority):

Main criterias:

- land-use distribution according to soil quality and topographic sequence: access to various types of units : most farm have access to upland red and black soils and few to lowland suitable for rice.
- % of net income from off farm activities
- type of diversification: livestock, perennial plants (fruits) and other type of diversification.
- level of motorization (tractor, small tractor "Kubota type", draught animals or no one
- size of the farm, available capital (balance) and land dynamic.
- local knowledge and know-how on agriculture according to status (migrant, origin, date of migration…)

Other potential criterias to be examined:

- food security vs self sufficiency
- food security/self sufficiency vs diversification
- livestock living capital as saving : other type of saving ?
- % of land as owner and in share cropping/renting
- % of family labour in total labour requirement

The **main tools** used in this type of research process are:

- The use of a participatory approach to obtain adoptable and more operational technologies more rapidly.
- "Inter-village exchange visits" between farmers from different locations to obtain feedback and to encourage discussion between farmers who have a research plot and those who do not.
- Surveys aimed at on-farm characterisation.
- A network of demonstration plots for the diffusion of information about technologies that have already been adapted and other technologies from on-farm trial results.
- a Farming System Reference Monitoring Network and sessions to develop scenarios.

The **results and outputs** are the following:

- Annual and perennial cropping patterns and technologies (technical pathways for monoculture, intercropping, agro-forestry systems, etc...), eventually associated with demonstration plots for information diffusion (trials that succeed can subsequently be used as demonstration plots).
- Manuals and publications for extension and information diffusion.
- An operational typology of situations and farmers leading to the identification of "topics of recommendations".
- A global overview of the possible adoption various technologies as a function of farmers' strategies and local conditions.

☛ An ongoing and dynamic database on farming systems using Olympe software.

The factors that determine change and the discriminators to be taken into account for the sustainable development of these commodities need to be related to each specific context. Important issues such as the effect of decentralisation, globalisation and its effects on prices, as well as on local economies and public policies, environmental topics (biodiversity, sustainability) are impossible to circumvent. One expected output would be the clear identification of the conditions required to ensure future projects are viable at the decision-making level. Farming system modelling through a farming system reference monitoring network provides a tool for technical choices made by decision makers with respect to agricultural policy. The main aim of this paper is to describe a possible global approach using a modelling tool which includes the identification of knowledge gaps and opportunities to promote actions and projects or the implementation of policies that respect the need for sustainable development, as well as those of local stakeholders, developers and researchers.
The historical dimension is very significant in this type of analysis even if economic commodity cycles can be very rapid. So far, rebuilding the past with a modelling tool and creating new evolution scenarios through prospective analysis can be linked to improve the efficiency of development-oriented research. The impact of technical change should take into account the effect of sustainability on both farmers' livelihoods and on the environment. Success in diversification strategies requires a certain number of conditions: access to capital or credit, technical options (innovations), access to information, markets, and to farmers' organisations in order to improve marketing, and so on.

The farming system level approach.
This approach privileges the comprehension of the structure of the farms and the integration of technologies to be developed (new cropping patterns or organisational improvements such as access to credit…) through a taking into account strategies trough an operational typology.

The decision-making aid and with the negotiation henceforth seems a priority as regards support with sustainable development. It systematically does not aim providing the optimal solution suggested by a model but at lighting the decision makers and negotiators in their showing the consequences d' a technical choice or organisational, impact of a measurement on the prices and the impact strength of the systems after a technical change.
The objective of such an approach is to optimize the efforts of extension by minimizing the "losses by abandonment" while proposing for each type of farmers the right technique; technology and services which are really adapted to him. The idea is better to include/understand the processes of innovations in progress and last, to seek the appropriable techniques and services according to their situation and of their strategic direction with respect to the technical change. One of the tools available is the network of farms of references.

6 Preliminary results

Key informants and Village survey

Table 1: In Boribo village

Date	Name	Position	Village	Date of birth	province of birth	Date of settlement	Code
04.05.2010	Mr. Khem Nob	chief of the village of Boribo	Boribo	1934		1997	HB1 and HB5
04.05.2010	Mr. Chun Vunn	Old person	Boribo	1959	Kandal	1961	HB2
05.05.2010	Mss. HUN Sokhor	Chief of ADA association in Boribo	Boribo	1970	Kampot		HB3
05.05.2010	Mr. DIN Voeun	Old person	Boribo				HB4
10.05.2010	Mr. TITH Mao	Main intermediary of Boribo	Boribo	1958	Battambang	1997	HB6
11.05.2010	Mr. XXX Sarath	Owner of a big tractor	Boribo				HB7
13.05.2010	Mr. SIENG Eng	Owner of big cattle of cow	Boribo	1949		1993	HB8
13.05.2010	Mr. SONG Chhean	General	Boribo	1954		1999	HB9

An Historical perspective analysis has been done on both villages (table 2).

The type of soils and land use per village is described in annex 6.

In Pich Changva village

Date	Name	Position	Village	Date of birth	province of birth	Date of settlement	Code
06.05.2010	Mss. PHENG Pheap	Chief of ADA association		1981		2001	HP1
06.05.2010	Mr. NGOY Roeum	Old person		1957		1996	HP2
07.05.2010	Mr. CHHIM Chhoeut	Old person		1961		1996	HP3
08.05.2010	Mr. OUN Lumong	Farmer with big tractor		1975		2007	HP4
10.05.2010	Mr. CHHEY Châk	labour force of a big owner		# 1970		1996 ?	HP5
11.05.2010	Mr. DITH Saroeun	chief of village		# 1960		1996	HP6
11.05.2010	Mss. Ourn and Mr. SONG Sarom	Main intermediary of Pich Changva (couple)		1960		2001	HP7

Source: preliminary village survey from students (B Ricard and C Chhoeum**, 2010).**

The Main cropping systems with annual crops are the following

Table 3

	Sowing-harvest dates	Crops	Comments
1st cycle	Mar/Apr – Jun/Jul	Mainly: Sesame, peanut, mung-bean	33 – 33 – 33 % of the surface
		Sometimes: with white maize	Ex: seen on black soils for rice
Between two cycles	Tillage to prepare the next sowing		Remains to know how many times? Only disc? Also tillage?
2nd cycle	Aug – Nov/Dec	Mainly: Red maize – sugar cane – peanut	80 - 10 - 10 of the Surface
		On rice land: rice	More frequently mentioned in Pich Changva
	?	Cassava	(since 2006): very less
After 2nd cycle	Dry season: Dec – Mar		
	=> Tillage to prepare the next sowing		Tillage = to dry the soil and to prepare the following crop
	Or 3rd cycle: sesame or mung-bean		Depends on rain and cash available to pay for seeds

Other crops and cropping systems

- Vegetables in home gardens
- Vegetables closed to the Okva river:cucumber, pumpkin, “trola”, watermelon
- Lowland rice on high water retention capacity soils:
- Cassava
- Cotton: started in 2008-2009 with only 16 families on 100 ha: abandon due to low prices.

Some perennials are currently being planted and developed*: Tan Ngen (longan tree type),* mango, coconut, custard apple, sapodilla and dragon fruit. The agricultural production evolution according to the history perspective analysis is presented in the table 4.

Table 2: Historical perspective analysis (Source B Ricard and C Chhoeum**, 2010)**

	Before 1975	1975 to 1996	1996 to 1999/2001	1999/2001 to 2010
Political context	Quite stable period except from 1970-1975 (civil war) => consequences here?	1975-1979: Pol Pot regime 1979-1989: Vietnamese occupation 1989-1996: resistance of KR	1996: reintegration of KR soldiers => distribution of land to KR soldiers whose most of them sell it back to the people	Nothing special mentioned during this period = quite stable. But, an old person said that people are still afraid of the KR soldiers.
Arrivals / Population / land occupation / infrastructure	1960: sale / distribution of land by the gvt => no land available anymore in 1964 People come bc it is a land of Chamcar, with good yields Sugar cane and cotton factories in Battambang	1975-1979: collectivism 1979-1996: War / mines => Departure to refugee camps mines, war, presence of Kmers rouges (KR) soldiers => fears: nobody come back Roads in poor situation Destruction of sugar cane and cotton factories	1996: Land is given to KR soldiers, and sold back to the new arrivals. only KR soldiers: few arrival of men without family The families from the area don't want to come back because they have to pay it! 1999: All is distributed, no land available anymore but few is cultivated bc purchases without settlement and a lot of forests. Roads still in bad situation	All is cultivated: forest = less than 20 hectares (from 1150) and is scattered. The complete family joined the men bc less mines, infrastructures (health care against malaria, road repaired etc) A lot of land has been sold to rich people (up to 100 ha by an American...!)
Nb of families	60-64: distribution of land => 300 families 75: 100 families (relatives) (?)	Almost nobody in 1996 : war situation, mines, departure to refugee camps Possinle massive departure after 79 (war and mines)	96: 4 families came back only but is mentioned that 16 families (the same) were present 99: 50 families came back	02: 100 bc many families come back bc attracted by the profit on peanuts (up to 1000 $/ha) 07: 156 families, 729 persons (2007 census)
Prices			97: 2000 Batt/ha (50 $/ha) 00: 320 $/ha	06: 1000 $/ha (bc road repaired) 07: 2000 to 5000 $/ha (bc land intermediaries) 10: 1000-1500 $/ha Rent of land in 2010 = 100 $/ha/year; 2008 = 25 $/ha/year

Cropping system évolution

	Before 1975	1975 to 1996	1996 to 1999/2001	1999/2001 to 2010
Crops + Markets	Sugar cane, Cotton => factories in Battambang Peanut, Sesame, Mung-bean, white maize Trees: coconuts, banana No red maize, no manioc (?)	No agriculture bc of war, mines Trees (coconuts, banana) cut and burnt	Cut of trees Sesame, mung-bean, peanuts, soja-bean, red maize (very few), white maize, rice, sugar cane Pb with fruit trees (banana and coconuts) bc of an insect	From 2005: intermediaries of red maize => more red maize Sesame, mung-bean, peanuts (less), soja-bean, white maize, rice Manioc and cotton (since 2007): less More fruit trees: mango, coconuts and longane (since 2000), tan ngen and dragon fruit (since 2004) for the richest people = to prepare the retirement + bc decrease of fertility Still problems with coconuts
Animal husbandry + Markets	Cows for animal traction (4-10 cows / household) Few big cattle > 50 to 100 cows Other?	No agriculture bc of war, mines	4-10 cows / families Few big cattle for reproduction and meat (Phnom Penh and Battambang)	2001: 50% of the farmers have a pari of cows for animal traction Sale of cows since 2000 bc: •Purchase of small tractors => especially in 2005-2007 •Difficulty to pay people to keep it and to cut herbs to feed them •Land closed by Chamcar => between 0 up to 2 cows / family now in Boribo Few big cattle (2 families in Boribo but none in Pich Changva) of more than 50 cows for the meat (Phnom Penh)
Agricultural techniques	Animal traction Animal manure used on lands No fertilizers No chemical (?)	No agriculture bc of war, mines	No chemicals except fertilizers from late 2000.	Start of **small tractors** in 2000 but very less, acceleration since 2005-2007 Start of **chemical fertilizers** in 2000 but rapid increase in 2005-2007 bc decrease of yields: 50% of the farmers use it, mainly small ones (to be confirmed). Increase of quantity / ha (from 1 bag to 1.5 bag). Almost no animal manure anymore. **Herbicides**: more since 2007. More **weeds** than before. Insects on all the crops, since 2007 Interest on **Conservation Agriculture** to recover the fertility
Yields / fertility / answers	50% higher than nowadays Yields quite stable		Twice a year => yields bad!! 01: peanut, sesame = 1 MT/year 01: Red maize = 7 MT/ha	Farmers purchase land, or invest in fruit trees bc yields decrease Now: peanut, sesame = 0.5 to 0.1-0.2 MT/ha Now: red maize = 4 MT/ha No more animal manure bc difficult and chemical fertilizers => bc monoculture of maize, land worked a lot since 96, insects on sesame, peanut, weeds, fertilizers have bad effects...

Table 4: Agricultural production evolution according to the history perspective analysis (B Ricard and C Chhoeum, 2010)

	Before 1975	1975 to 1996	1996 to 1999/2001	1999/2001 to 2010	
Crops + Markets	Sugar cane, Cotton => factories in Battambang Peanut, Sesame, Mung-bean, white maize Trees: coconuts, banana No red maize, no manioc (?)	No agriculture bc of war, mines Trees (coconuts, banana) cut and burnt	Cut of trees Sesame, mung-bean, peanuts, soja-bean, red maize (very few), white maize, rice Pb with fruit trees (banana and coconuts) bc of an insect		From 2005: intermediaries of red maize => more red maize Sesame, mung-bean, peanuts (less), soja-bean, white maize, rice Manioc and cotton (since 2007): less More fruit trees: tan ngen, mango, coconuts for the richest people = to prepare the retirement + bc decrease of fertility Still problems with coconuts
Animal husbandry + Markets	Cows for animal traction (4-10 cows / household) Few big cattle > 50 to 100 cows Other?	No agriculture bc of war, mines	4-10 cows / families Few big cattle for reproduction and meat (Phnom Penh and Battambang)	Sale of cows since 2000 bc: •Purchase of small tractors => especially in 2005-2007 •Difficulty to pay people to keep it and to cut herbs to feed them •Land closed by Chamcar => between 0 up to 2 cows / family now Few big cattle (2 families) of more than 50 cows for the meat (Phnom Penh)	
Agricultural techniques	Animal traction Animal manure used on lands No fertilizers No chemical (?)	No agriculture bc of war, mines	No chemicals		Start of small tractors in 2000, acceleration in 2005-2007 Start of fertilizers in 2000 but rapid increase in 2005-2007 bc decrease of yields: 50% of the farmers use it, mainly small ones (to be confirmed) Herbicides: more since 2007 Interest on Conservation Agriculture to recover the fertility
Yields / fertility / answers	50% higher than nowadays Yields quite stable		Twice a year => yields bad!! 01: peanut, sesame = 1 MT/year 01: Red maize = 7 MT/ha	Farmers purchase land, or invest in fruit trees bc yields decrease Now: peanut, sesame = 0.5 to 0.1-0.2 MT/ha Now: red maize = 4 MT/ha No more animal manure bc difficult and chemical fertilizers => bc monoculture of maize, land worked a lot since 96, insects on sesame, peanut, weeds, fertilizers have bad effects...	

Identification of a pre typology

Two perspectives have been used to identify the criterias for a pre-typology ((B Ricard and C Chhoeum, 2010).

- **An "official" speech**: from the chief of village

Table 5.

Size (ha)	Number of families	Comments
> 10	1	Mr. MAO
7-10	34	Strategy oriented on land acquisition
5	50% (=> 78), 80% as for the General	Settlement in 2001
2-3	15% (=> 23)	New comers from 2002-2003: free access to land or purchase
No land	6	Permanent workers in local Estates (situation close to a "captive labour market" with no salary and exchange of services.

Table 5

- **An "out of local power speech"**: from the main collectors/traders/middlemen and other people.

Table 6

Size (ha)	Number of families	Comments
52	1	Rich land owner buying land
25 < S < 50	4	Rich land owner buying land with overseas capital
10 < S < 15	15% (=>23)	People settled in 1996-2001 buying land with capital provided by chamcar crops
5	70	Settled in 1996-2001
2 < S < 3	20% (=>31)	Young farmers with land from heritage, People settled in 2001-2002
1	4-5	Poor people with land given by landlords
No land	10	Landless farmers working on landlords estate : no salary provide but access to basic needs and housing.

Such preliminary survey provide key elements to identify criterias for the final pre-typology

Yield evolution and perception

The yields of the red maize is a good indicator as it has been sown for a long time and during the second cycle, that is to say when there is no shortage of rains.

Code of the interviews	Yield of red maize (MT/ha)														
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
HB1-HB5														"5-6"	
HB2															
HB3											4-5	4	3	2,50	
HB4												7		4	
HB6				3	5					4			4	3	
HB7														4	
HB8															
HB9				6	6	6	6	6	6	4					
HP1														4	
HP2							7-8	6	5					4	
HP3														3.5-5	
HP4															
HP5				5	5	5	5	5	5	5	5	5	3,5		
HP6															
HP7										6-7	6	5	4	4	

Globally, corn yield decrease from 7-8 t/ha in 1993-1995 to 4-5 t/ha in 2010. We took a scheduled corn yield decrease from 4t/ha to 2.5 for the next 10 years in our simulation (see chapter 9.

The main constraints to agricultural production mentioned by local farmers are the following:

- strong negative impact of weeds and cost of weeding. Chemical weeding seems to be more favoured by farmers.
- negative impact on the long run of the decreasing fertility (“mining agriculture)
- negative recent impact of pests and insects since 3 years (with new costs for insecticide..).

Obviously, CA cropping patterns that may decrease labour cost and weeding costs will be accepted and probably favourably adopted. One of the main problems remains the investment required for the first 2 or 3 years compared to current traditional practices.

7 The References Farming System Monitoring Network (RFSMN): a comprehension tool of farmers' strategies and follow-up evaluation.

A References Farming System Monitoring Network (RFSMN) is a set of representative farms that show various agricultural situations dependent on morpho-pedological and climatic units as well as socio-economical situations, resulting from a typology. Farms are surveyed in-depth then followed and updated every year in order to measure i) the impact of the projects' implementations, ii) the development policies in progress, iii) the resulting innovations' processes. The objective through a follow-up is to measure the impact, the evaluation, the prospective analysis and decision-making process inside projects (choice of technologies to be promoted and level of intensification according to farm types for example…). A prospective analysis (framed n° 3) allows the comparison between potential scenarios and reality. The final objective is to allow development operators in contract with projects to measure impacts and re–orientate rapidly their actions.

Data are obtained by farm characterization surveys, carried out in 2007, that collect detailed information on the processes of innovations, the sources of agricultural and non-agricultural incomes according to their technical pathways for all cropping and livestock systems, the various activities and overall constraints and opportunities which affect farmers' strategies. 157 exploitations have been surveyed in zones covered by operators. A meeting of "restitution" on the principal results to the operators leads to a dialogue and identification on a final typology and the final choice of representative farms of the network (see Table 1). Farming systems modelling use the Olympe software. The unit of analysis is the "system of activity" composed of a household and a farm, including all agricultural and not agricultural activities, and sources of incomes and household expenses.

Parallel to the RFSN, the project sets up procedures of plot and farms levels data acquisition whose objective is to obtain detailed and precise data allowing simulation and further prospective analysis,. A general "plot database" common to all contracted operators allows the identification of cropping pattern, with data effectively observed in the fields, that will feed the simulation. With the adoption of "farming system level approach", rather than the traditional "plot level", the project sets up "farming books", on a voluntary basis in order to record farm evolution, description of cropping systems and main simple economic factors and analysis (gross and net margin, return to labour) and to observe tendencies and farms' trajectories.

Frame n°1 : the software OLYMPE (Penot, 2003)

Detailed knowledge of local farming systems and farmers' strategies in different contexts such as pioneer zones, rehabilitation areas or traditional tree-crop belts can contribute to building improved and better adapted solutions to help farmers make the right decision about their future investments at the right time. In collaboration with INRA[2] and IAMM, CIRAD developed a software called " Olympe " that enables the modelling of farming systems (Penot 2003). Olympe is an economic modelling tool to develop farming simulations in order to help individual decision-making at farm level and may be used for project decision making. There is also a module that allows for analysis at the groups of farms scale. Positive or negative externalities can also be integrated thus enabling an approach that takes into account C sequestration from tree crops, the effects of pollution, or any other negative or positive externalities connected with agricultural production.

[2] INRA = Institut National de la Recherche Agronomique, IAMM = Institut Agronomique Montpellier Méditerranée.

The first aim of using "Olympe" as a tool to model farming systems is to improve farmers' understanding of their own situation, and of their socio-economic context. Farming systems modelling associated with a farm typology can therefore be used to help projects test scenarios with various types of technologies in order to assess what is the right technology for the right farmer at the right time. Then, it aims to provide guidelines for agricultural and development policies for institutions and/or donors. Olympe can be used in a variety of situations and with different methodological approaches: comparison of cropping systems, the economics of farming systems and resource management ("farm management counselling"[3]), prospective analysis, regional approach, and even for "role game."
Olympe simulator has been developed by J-M Attonaty (INRA Grignon, France) and associated partners from CIRAD and IAMM. It builds simulations for one or more stakeholders, provides results and summarizes the results as a function of the needs of each stakeholder (Figure 1). On the one hand, the simulator enables the simulation of the three years before the first year of the simulation. In this way, each stakeholder can compare the past as simulated by the model with his own results. And on the other hand, each stakeholder can analyze the results obtained by the model for a given number of years (by series of 10 years) using his own criteria (economics, labour requirements, risk factors, etc…).

Olympe is based on the systemic analysis of farming systems (see frame 1). The overall objectives of using Olympe are the following:

- To identify smallholders' constraints and opportunities in a rapidly changing environment in preparation for the adoption of new cropping systems or any other organisational innovation.
- To understand farmers' strategies and their capacity for innovation.
- To assess their ability to adapt to changing economic conditions, price crises and technological change.
- To provide a tool to understand the farmers' decision-making process;
- To put information about farming systems in the social and economic context (through a regional approach).
- To undertake prospective analysis and build scenarios based on climatic risks, major climatic events such as "El Nino years" and fluctuating commodity prices.

It is possible to build several scenarios as a function of changing prices, climatic events and different types of risks. It is also possible to calculate impact at the regional scale on various groups of farms (as a function of a given typology). Building scenarios enables this type of prospective analysis as well as the ability to test the robustness of any decision or technical choice. Data analysis obtained with Olympe should be discussed with farmers using a participatory approach in order to validate scenarios and guarantee a high degree of representativeness and accuracy. For instance, a network of selected representative farms can be monitored for several years with two main objectives: firstly, to diagnose constraints and opportunities and, secondly, to measure the impact of technical change. One of the main outputs of such an approach is the assessment of the impact of technical alternatives or choices at the level of the farming system, both from an economic and environmental point of view. Olympe is fed with data from appropriate farming systems surveys and can then provide key information in terms of diagnosis and later, in terms of prospective analysis

[3] "Conseil de gestion" in French.

Olympe can be downloaded free of any chares on the following websites

Objectives of a FSRMN as a management tool

Management, along with characterisation, is one of the main functions of Olympe and the detailed description and understanding of economic mechanisms at the level of the farm that produce income. Olympe can be used for the management of any agricultural enterprise (whether smallholdings or not, and irrespective of the size of the enterprise) linked to a true contextual socio-economic analysis so as to take into account the overall environment (including its history). In the case of Cambodia; modelling here concerns small size familial farms. The financial impact of agricultural and off-farm activities on the farm's immediate environment can be assessed through quantifiable positive or negative "externalities". A pragmatic and realistic use would be farming counselling using adaptable and refutable data. Such data should be used in a process of validation by farmers through "feedback meetings". FSM will be used for two main purposes: direct "farming counselling" with commercial farms and perspective analysis with scenarios on technical change with projects and associated operators to identify relevant technologies for the relevant type of farmers. Olympe is not only a tool with an apparently "mechanical" approach to budget calculations. Coupled with the socio-economic analysis of decision-making processes (linked with innovation processes), it importantly reveals farmers' strategies and trajectories.

Coupled to the analysis of constraints and opportunities, and taking into account social and environmental variables, Olympe makes it possible to quantify technical decisions from an economic point of view. Economic analysis (budgets, margins, incomes, cost-benefits etc... linked with non-economic factors and in particular social factors, enables the use of Olympe as a tool for dialogue, mostly for representation purposes but sometimes for awareness raising of stakeholders though negotiation

Modelling of standard representative farms

For each identified type, 2 to 4 farms could be modelled with the Olympe software.
It is very important to preserve a certain degree of operationality in the implementation of the RFSMN. The modelling of real farms is a real challenge in the objective of a final consensus of all final users to promote final appropriation of the tool by operators. Rules and standards were thus defined to obtain a functional modelling (with the participation of Méduline Terrier in 2008, MsC student from SUPAGRO Montpellier) on the following points: balance between operationality and detailed structural farm definition, taking into account of subsistence farming, calculation of an "agricultural income" (without subsistence farming), definition of a total income including off-farm, identification of simple ratios of farm management to assess risks, definition of several categories of "cropping systems" for further simulation.

3 types of cropping patterns might be identified:

- Traditional cropping patterns
- Traditional "improved" cropping patterns: already including knowledge and know-how from various projects
- Standard "cropping patterns" resulting from plot database analysis used for the prospective analysis in order to identify the best technologies for each farm type taking into account access to markets, knowledge, etc ….

Identification of accurate cropping patterns is a key function in farming system modelling for decision making process support.

Use of the "plot databases" from project operators for the construction of "standard cropping patterns".

The local databases could provide reliable indicators on farmers' technical plot pathways which are monitored by the project so as to build average standard cropping patterns. We need at least a minimum of 10 plots with a homogeneous average of production (Coefficient of variation lower than 30%).

The final objective is to make it possible the project to measure the impact of the development actions thanks to the installation of a network of farms of key references given hand with the exploitations chosen in partnership with the operators and modelled. The data are obtained by the means of investigations of characterization of the farms, collecting detailed information into the processes of innovations, the sources of revenue agricultural and non agricultural according to the adopted technical routes, the various activities and overall into the constraints and opportunities which weigh on the farms and the country strategies. The databases possibly available can provide reliable indications on the country cultivation methods of the

pieces followed by the project to build average standard technical routes by type and year of SCV.

The global approach is based on the "farming system approach" (taking into account the farm level and not the plot level), knowledge on innovation processes and farmers' strategies and farming system modelling for prospective analysis through a reference farming system monitoring network.

The software enables the creation of scenarios based on various types of adoption and modification of technical patterns (cropping or livestock), more or less intensive. Then, the objective is to test the robustness of technical choices, and then the impact on production systems caused by climatic risks (cyclones, output lower due to the attack on a plant's health, excess or lack of water, etc…) or economic (impact of the volatility of the farm prices and the inputs). Indicators (standard formula Excel type) allow to calculate ratios and variables of management such as:

- return to labour and capital
- total calculated income before self-consumption
- net income per familial labour unit (person effectively working on the farm)
- real net income (after subsistence and self-consumption) equivalent to "net balance"…
- indicators on the control of self-consumption with a comparison to farmer's declaration, subsistence farming being a very important factor.
- Economic ratios allowing to measure risks (compared to credit): return to capital, debt ratio….

The identification of simple ratios and the consequent analysis of the financial farm situation after a technical choice, a real or simulated one, largely facilitated the appropriation by operators and led to a better integration of their recommendations, while taking into account the concepts of risk for the farmer (in particular with respect to the credit of countryside). For example: where is the best output from an investment of 2 bags of NPK: fodder for dairy production, DMC on upland, DMC on lowland, irrigated rice, dry-season crop? Such an approach allows operators to better include and understand farmers' strategies in production factors allowance and finally in the farmers' priorities of resource allocation according to their knowledge, their own experimentation, their potential opportunities and their current situation.

Risks lead to shocks and disturbances. Impact strength can be regarded as the capacity of a system to overcome disturbances while maintaining its vital functions, its structure and its capacities of control. It is thus important for the capacity of a system to be able to resist by maintaining the essence of its structure and "modus operandi" while including the possibility of any change. It is based on the conditions which maintain an initial balance though potentially unstable which can lead to another balance. One can measure it by the magnitude or the level of disturbances a system can resist or absorb until the rupture or the change of that system's structure. The robustness can then be interpreted like a particular impact strength according to a definition close to that used in statistics.
Risks are assessed through the use of the "hazard module" in Olympe which enables the creation of scenarios with any changes in inputs/output prices as well as production and yield.

Risk assessment through prospective analysis

Most farmers will already have developed a diversification strategy in the face of market uncertainties, price volatility and climatic risks. They may also have integrated local opportunities for particular crops (for example oil palm with private estates that provide development schemes). As a consequence, prospective analysis may provide ideas for the future, potential or possible trajectories, an assessment of the impact of a technical choice or of several different strategies, assessment of the robustness of farming systems as a function of fluctuations in commodity prices or of climatic risks, and perhaps the definition of "thresholds" for risks, profitability and viable alternatives. In this section, we will explore how Olympe can provide data on such hypotheses and how scenarios can be built which are then discussed with the farmer to validate the simulation.

First of all, the data set needs to be clearly defined. Farming systems are created in Olympe according to a typology that may change as a result of the prospective analysis. The scenarios have to be defined as a function of real possibilities. Historical records and data on prices, and agrarian history can help to identify the scenarios. The prospective analysis is used for the following purposes: i) to test the impact of price volatility of commodities/inputs, to assess the impact of climatic events and reduce risks and test the robustness of technical choices in the short, medium and long term, ii) to assess the impact of farmers' strategic changes on the structure of farming systems and income, iii) to define financial or economic thresholds beyond which profitability becomes too low or risks become too high, iv) to measure capital/credit requirement to fund any technical change (intensification or diversification..) for technology adoption or adjust the structure of the farming system, v) to measure input and output flows and to assess the impact of any decision on profitability, returns to labour and returns to investment.

From a farmer's perspective, the objective is clearly to assess the potentials and risks, and to trace potentially profitable farming pathways through the range of possibilities. From a developer's perspective, better knowledge of the potential economic impact of decisions helps to define better farm counselling, and to measure the potential impact of extension activities and recommendations. For the developer, better knowledge helps to define common descriptors for development, risks and the impact of agricultural policies and markets for both farmers and developers.

Olympe software provides the ability to answer different questions in the study of farmers' behaviours and to assess the impact of different activities, the changes in farming practices and the decision-making processes. Simulations of farming potential, risk factors and decisions concerning the assignment of production factors (capital, work, land) in the medium and long term are a clear advantage over other tools that are basically more focused on annual results. The economic forecast of incomes, monthly treasury, and labour availability per activity allows the evaluation of the viability of technical or organisational choices to define technical thresholds and possible scenarios for change. FSM makes possible the readjustment of an observed reality of an existing farm, and its future change (real and potential through prospective analysis) and the different impacts these decisions will have.,

The use of FSM has shown that simplification of a given situation is not synonymous with a reduction in, or a loss of information, and consequently is (not) a failure to understand the implementation of systems. FSM generally provides a tool for dialogue and for awareness raising among the different stakeholders, including the producers themselves. When properly validated by those involved, FSM is an operational representation of the decision-making process and of its components.

Modelling therefore allows scenarios and potential pathways to be designed as a real function of needs, requirements and possibilities, at the same time taking into account all non

economic factors that specifically characterise the rural world and agricultural production. Farmers do in fact produce a large variety of goods and services in addition to agricultural production; i.e. the conservation of biodiversity, the sustainability of the land and so on. These contributions include the multifunctional aspects of agricultural activities and have to be integrated into management and the design of strategies.
On the other hand, when FSM is linked only to the farmer (as a producer), the need quickly appears to couple this "single-player" farm analysis with other players involved (traders, other producers, decision makers, transporters, etc.) so as to include the significant interactions between markets, stakeholders and the environment. Results obtained with Olympe should be coupled with other tools, particularly for better spatial representation (SIG) or interaction (MAS).
Farming systems modelling can be used as a prospective tool to build scenarios about potential farm pathways, and to define agricultural policies, recommendations, to test the viability of recommendations as a function of local constraints, to assess different impacts, and the matching of policies to the real situation faced by the farmers (See figure 1) . Risks analysis is a key component in this approach (see figure 2).

Figure 5: Definition of prospective scenarios:

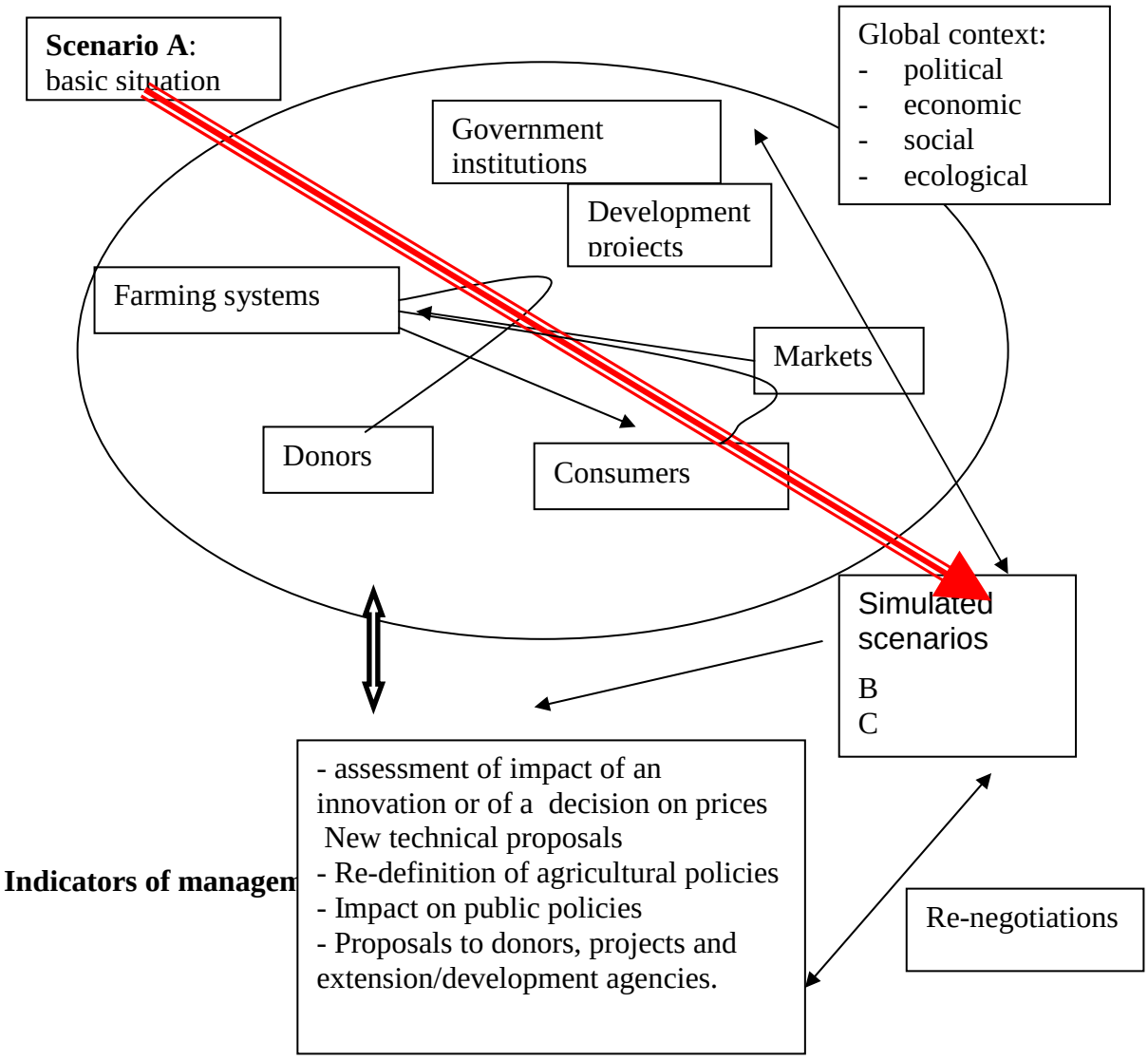
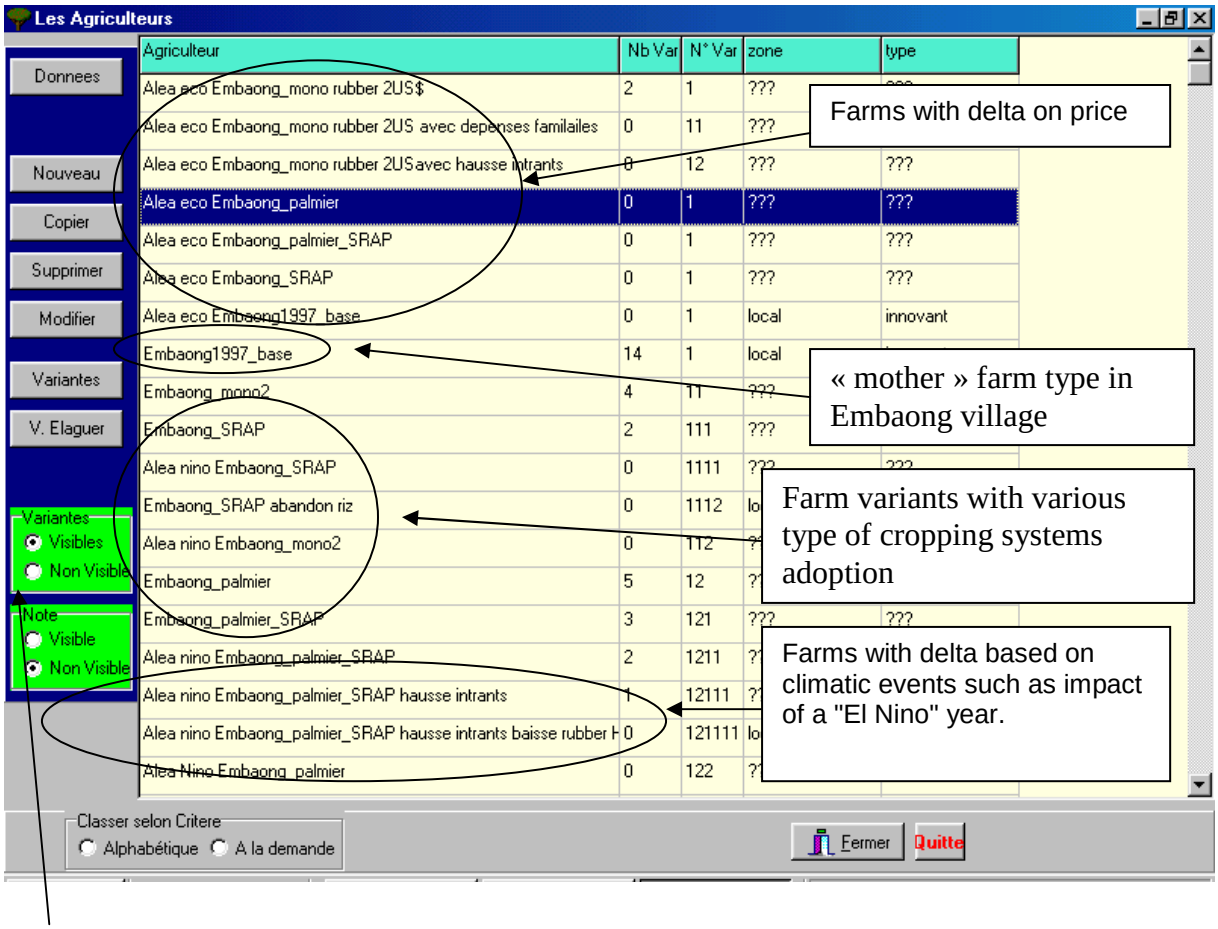


Fig 6: Risk analysis trough creation of farm "variants" using various type of cropping system or technology adoption as well as the « delta » module (hazards) for climatic risks



8 Procédure d'actualisation du réseau de ferme de référence :

The conventions for modelling are explained in the report from of Médulline Terrier: "Installation of the FSRMN in BV/lac project area, lake Alaotra, Madagascar. Methodology: conventions and rules of use" (2008). The creation of scenarios of references is also clarified in the report of Sophie Cauvy,(BV-lake, May 2009) Olympe software is not initially designed systematically to follow precisely farm plots. Ii is however possible to make it if necessary by coding the cropping patterns. Olympe is a software which allows a technico-economic analysis and simulations over 10 years or more starting from results the one year under review. We use Olympe to follow a network of farms of references over 5 years by adapting it. The case of CA is a strong representation of a real change of paradigm. The needs for various services with agriculture (extension, credit, provisioning, marketing…) is changed. The use of modelling tools can thus largely contributed to the reinforcement of appropriation.

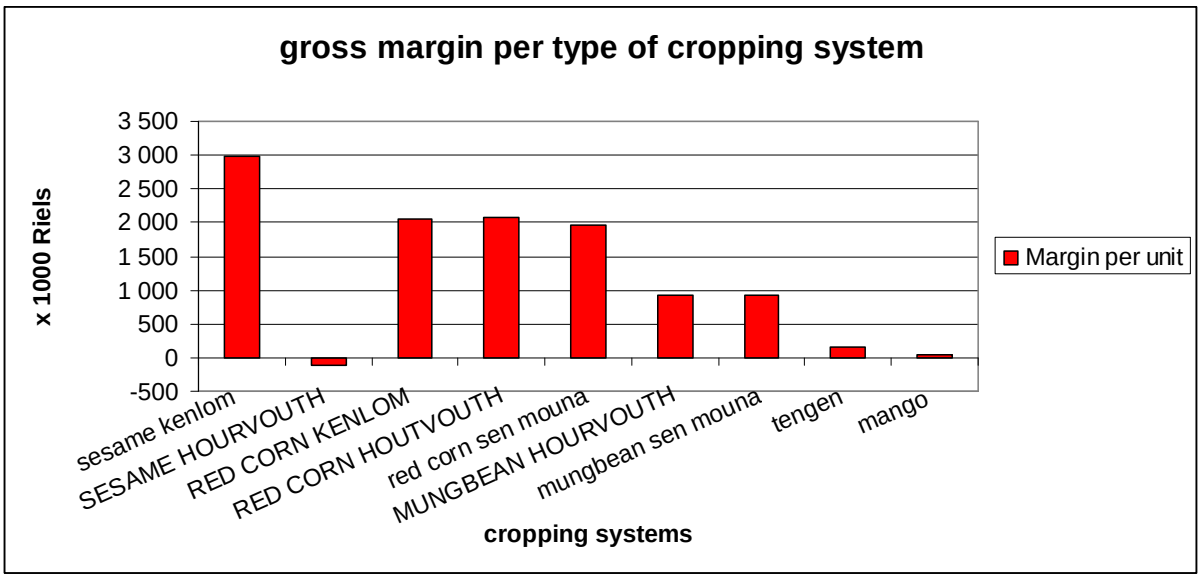
It would be interesting to continue the follow on the use of Olympe, possibly by additional trainings of level 2 (improved analysis of data sets provided by users of level 1 olympe training) on the use of the Olympe tool (into 3 or 5 days according to the data and the number of participants) with sets of abundant data by the users trained at this first session.

9 Modelling examples for 3 surveyed farms.

Introduction

A mini survey has been implemented in the Battambang area to test the questionnaires et see what could be the main hypothesis concerning the area.. 3 farmers have been modelled: Mr Kenlom with 7 ha of Chamcar (upland), Mr Houtvouth with 3 ha of chamcar and Mrs Sen Mouna with only 1 ha of chamcar. The data from the 2009/2010 season have been integrated.
It is quite clear that the first agricultural cycle with sesame, mungbean, white corn or peanut is very risky. The second crop, red corn is rather still having a relatively good yield. However , the very fragile type of soils and the very small amount of fertilisation provided to the crop indicates, as seen in the Konpong Cham area, that yield will decline in the next 10 years. We took the hypothesis that red corn yield will slightly decrease from 4 t/ha today to 2.5 t/ha in 10 years time.
The CA systems proposed by PADAC, based on a millet bio-pump crop in the first year and integration of *Styloxanthes* as covercrop, are presented with 3 variations : a high profile with yields increased to 6,5 t/ha, a medium profile with yield at 5 t/ha and a low profile where current yield , 4 t/ha , a re maintained
The cropping systems, traditional and CA, are presented in the tables in annexe 5. A synthetic table has been set up:

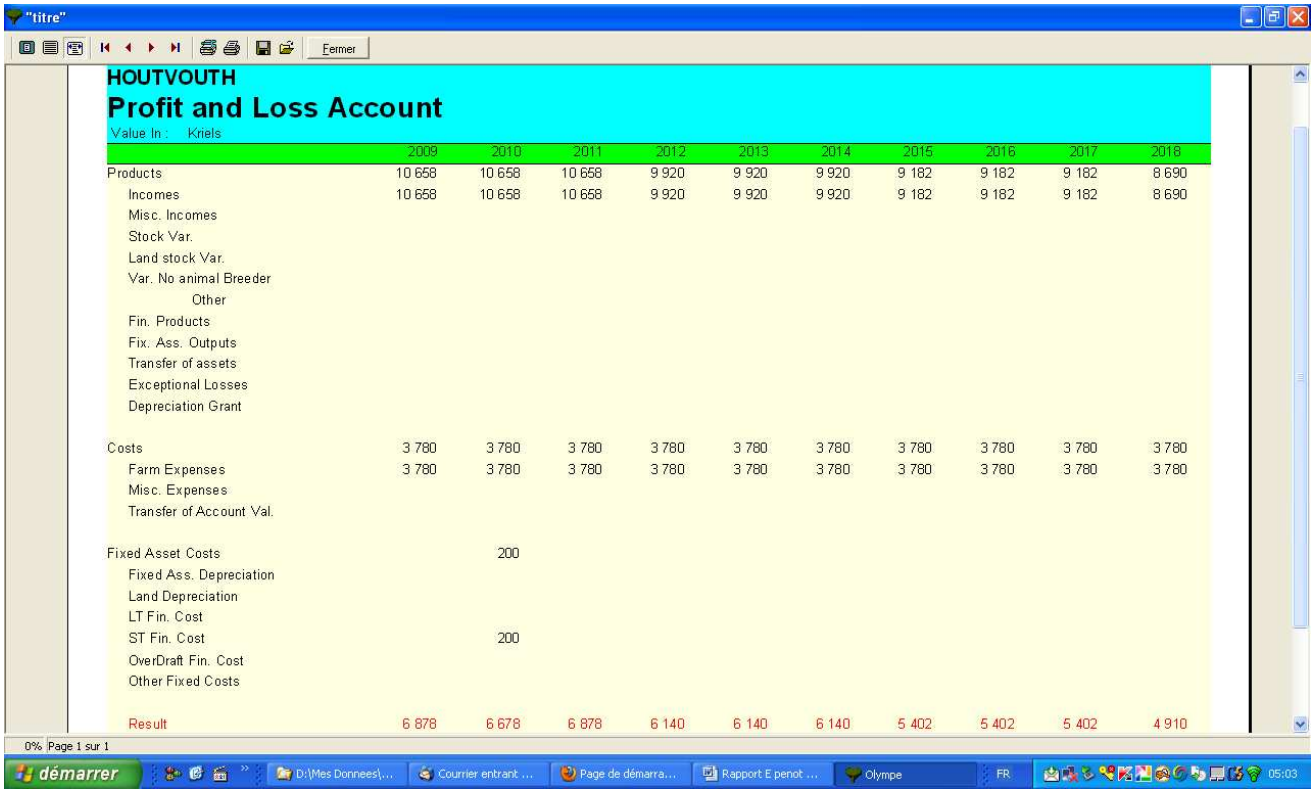
Figure 7 : Synthetic table; gross margin for each cropping system in the simulation



All cropping and livestock patterns can be compared in order to select the most appropriate for each type of famers.

Rapid economic analysis with Olympe : income (NAI) and balance evolution
An example of the main economic results from the "general farm account", called profit and loss account (CEG or Compte d'Exploitation General in French) is presented in the following table 7 with the "result" or Net Agricultural Income" (calculated before self consumption:

Table 7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Profit and Loss Account

Value In : Kriels

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Products	10 658	10 658	10 658	9 920	9 920	9 920	9 182	9 182	9 182	8 690
Incomes	10 658	10 658	10 658	9 920	9 920	9 920	9 182	9 182	9 182	8 690
Misc. Incomes										
Stock Var.										
Land stock Var.										
Var. No animal Breeder										
Other										
Fin. Products										
Fix. Ass. Outputs										
Transfer of assets										
Exceptional Losses										
Depreciation Grant										
Costs	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780
Farm Expenses	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780
Misc. Expenses										
Transfer of Account Val.										
Fixed Asset Costs		200								
Fixed Ass. Depreciation										
Land Depreciation										
LT Fin. Cost										
ST Fin. Cost		200								
OverDraft Fin. Cost										
Other Fixed Costs										
Result	6 878	6 678	6 878	6 140	6 140	6 140	5 402	5 402	5 402	4 910

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The main economic outcomes from Olympe are summarized as following:

At the cropping or livestock system :

- margin (gross margin) = value of the production – operational costs
- return to labour per hour (family labour id provided in hours in Olympe)

At the farming system level;

- margin = sum of all gross margin from all cropping and livestock systems
- result = net margin = net agricultural income (NAI) : margin + miscellaneous income – miscellaneous expenses – fixed costs – financial costs

The NAI is calculated before self-consumption (as all production is effectively sold) that enable the comparison of the economic efficiency of agricultural activity for all farms.

- net total income (NTI) = result (NAI) + off farm income
- balance = NTI – family expenses (including self comsumption).

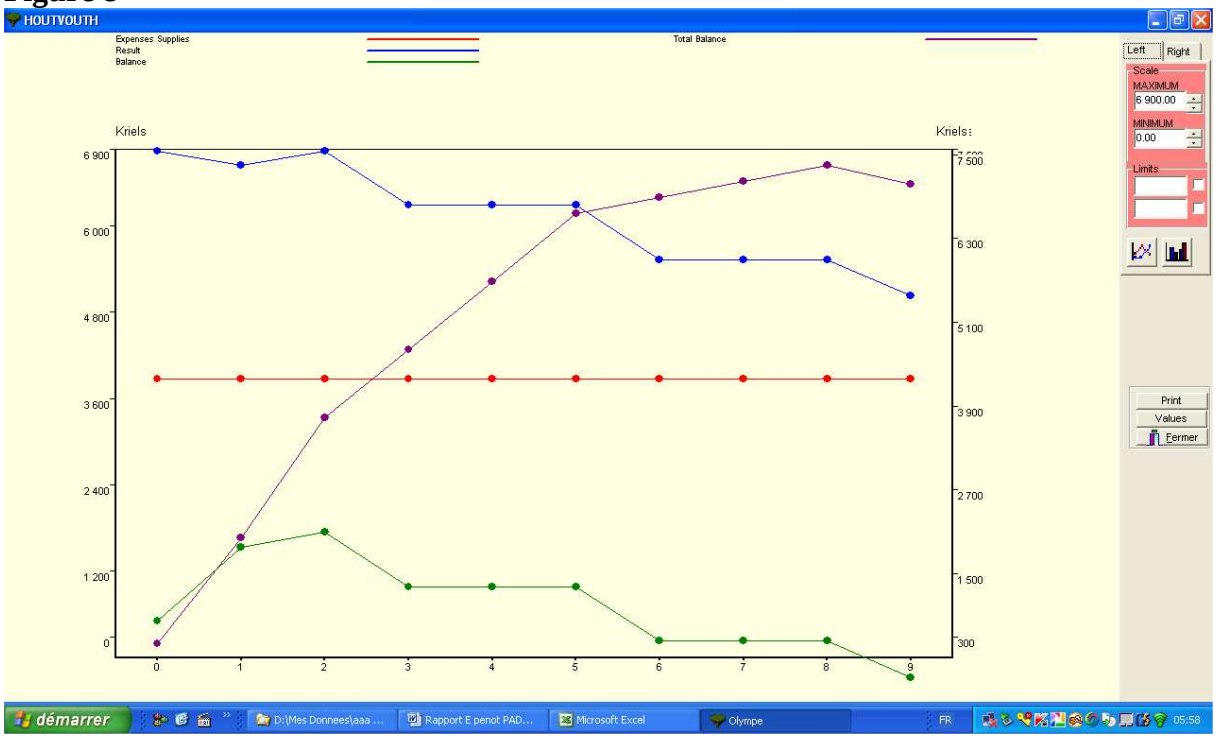
It is exactly as the farmer was buying to himself what he effectively self consume (at the same price as selling price of course).
We consider the "activity system" as a farming system and a livelihood. Therefore off farm income as very important as it is complementary to farm income or it can be re injected in farming activity (off farm income can be reinvested in farming as a source of funding). The particularity of agricultural production is that most farmers do not separate the farming account from the private account. For most farmers, the perception of their "income " is more close to the balance rather than the result (NAI). In Olympe, we do separate the farming account from the private account from practical reason and a better income generation process understanding. Therefore, we take into account both result, net total income and balance for our economic analysis. Balance is what remains in farmer' pocket at the end of the year after all expenses (farming and family expenses). It is equivalent to the theorical capacity of investment (cash flow). The main tables provided by Olympe are the following;

- Table of quantities: allow to measure the flows in and out the farm
- The farm account providing the result (NAI)
- The receipt expenses summary providing the margin (gross margin) and balance (see table 8)
- The "margin" table that allow to calculate all margins per activity and know the distribution of income sources between activities
- "customized tables" with all indicators and variables that the user may create on purpose in Olympe (see table 9 for a specific example with several analytic ratios).

Olympe enable to compare up to 10 farmers on a specific list of items defined by the user

Some figures can be immediately set up for trend analysis such as follow (figure 8):

Figure 8



Red = expenses supplies or operational costs,
blue = result,
green = balance and
purple total or accumulated balance.

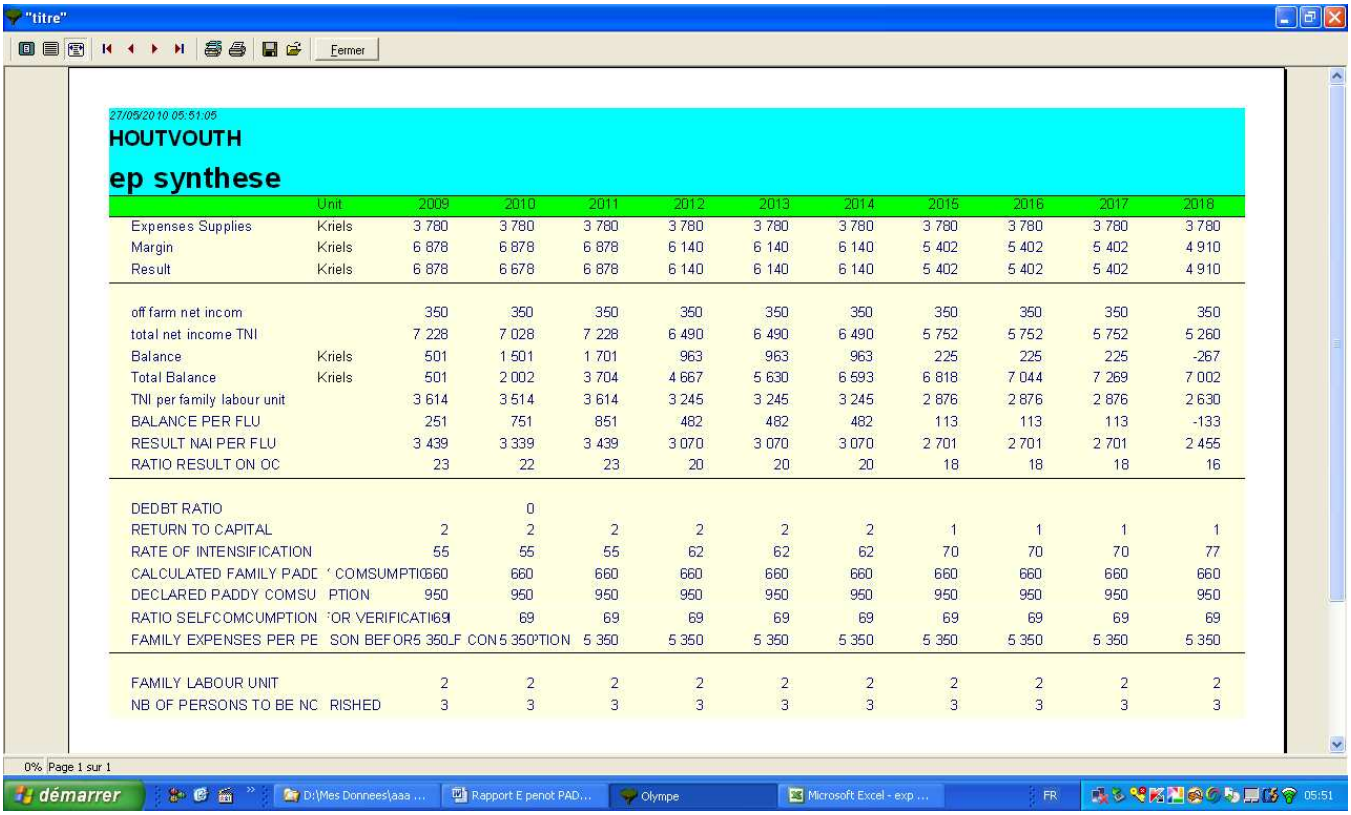
Agriculteur HOUTVOUTH **Table 8**

expenses and incomes farm account

Valeurs en Kriels

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
products											
	Cereals	8658.00	8658.00	8658.00	7920.00	7920.00	7920.00	7182.00	7182.00	7182.00	6690.00
	Proteaginous plants	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00
TOTAL		10658.00	10658.00	10658.00	9920.00	9920.00	9920.00	9182.00	9182.00	9182.00	8690.00
operationnal charges											
	Fertilizers	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80
	insecticide	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00
	herbicide	84.00	84.00	84.00	84.00	84.00	84.00	84.00	84.00	84.00	84.00
	External Labor	1450.00	1450.00	1450.00	1450.00	1450.00	1450.00	1450.00	1450.00	1450.00	1450.00
	services	2160.00	2160.00	2160.00	2160.00	2160.00	2160.00	2160.00	2160.00	2160.00	2160.00
TOTAL		3779.80	3779.80	3779.80	3779.80	3779.80	3779.80	3779.80	3779.80	3779.80	3779.80
margin		6878.20	6878.20	6878.20	6140.20	6140.20	6140.20	5402.20	5402.20	5402.20	4910.20
loans											
	Emprunt	0.00	2000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Remboursement	0.00	2000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Interet	0.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net		0.00	-200.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Balance		501.20	1501.20	1701.20	963.20	963.20	963.20	225.20	225.20	225.20	-266.80
cumulated balance		501.20	2002.40	3703.60	4666.80	5630.00	6593.20	6818.40	7043.60	7268.80	7002.00

Table 9 : specific "customized" table with analytic indicator created by the user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	Unit	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Expenses Supplies	Kriels	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780	3 780
Margin	Kriels	6 878	6 878	6 878	6 140	6 140	6 140	5 402	5 402	5 402	4 910
Result	Kriels	6 878	6 678	6 878	6 140	6 140	6 140	5 402	5 402	5 402	4 910
off farm net incom		350	350	350	350	350	350	350	350	350	350
total net income TNI		7 228	7 028	7 228	6 490	6 490	6 490	5 752	5 752	5 752	5 260
Balance	Kriels	501	1 501	1 701	963	963	963	225	225	225	-267
Total Balance	Kriels	501	2 002	3 704	4 667	5 630	6 593	6 818	7 044	7 269	7 002
TNI per family labour unit		3 614	3 514	3 614	3 245	3 245	3 245	2 876	2 876	2 876	2 630
BALANCE PER FLU		251	751	851	482	482	482	113	113	113	-133
RESULT NAI PER FLU		3 439	3 339	3 439	3 070	3 070	3 070	2 701	2 701	2 701	2 455
RATIO RESULT ON OC		23	22	23	20	20	20	18	18	18	16
DEDBT RATIO			0								
RETURN TO CAPITAL		2	2	2	2	2	2	1	1	1	1
RATE OF INTENSIFICATION		55	55	55	62	62	62	70	70	70	77
CALCULATED FAMILY PADD	' COMSUMPTI	660	660	660	660	660	660	660	660	660	660
DECLARED PADDY COMSU	PTION	950	950	950	950	950	950	950	950	950	950
RATIO SELFCOMCUMPTION	'OR VERIFICATI	69	69	69	69	69	69	69	69	69	69
FAMILY EXPENSES PER PE	SON BEFOR	5 350	F CON	5 350	TION	5 350	5 350	5 350	5 350	5 350	5 350
FAMILY LABOUR UNIT		2	2	2	2	2	2	2	2	2	2
NB OF PERSONS TO BE NC	RISHED	3	3	3	3	3	3	3	3	3	3

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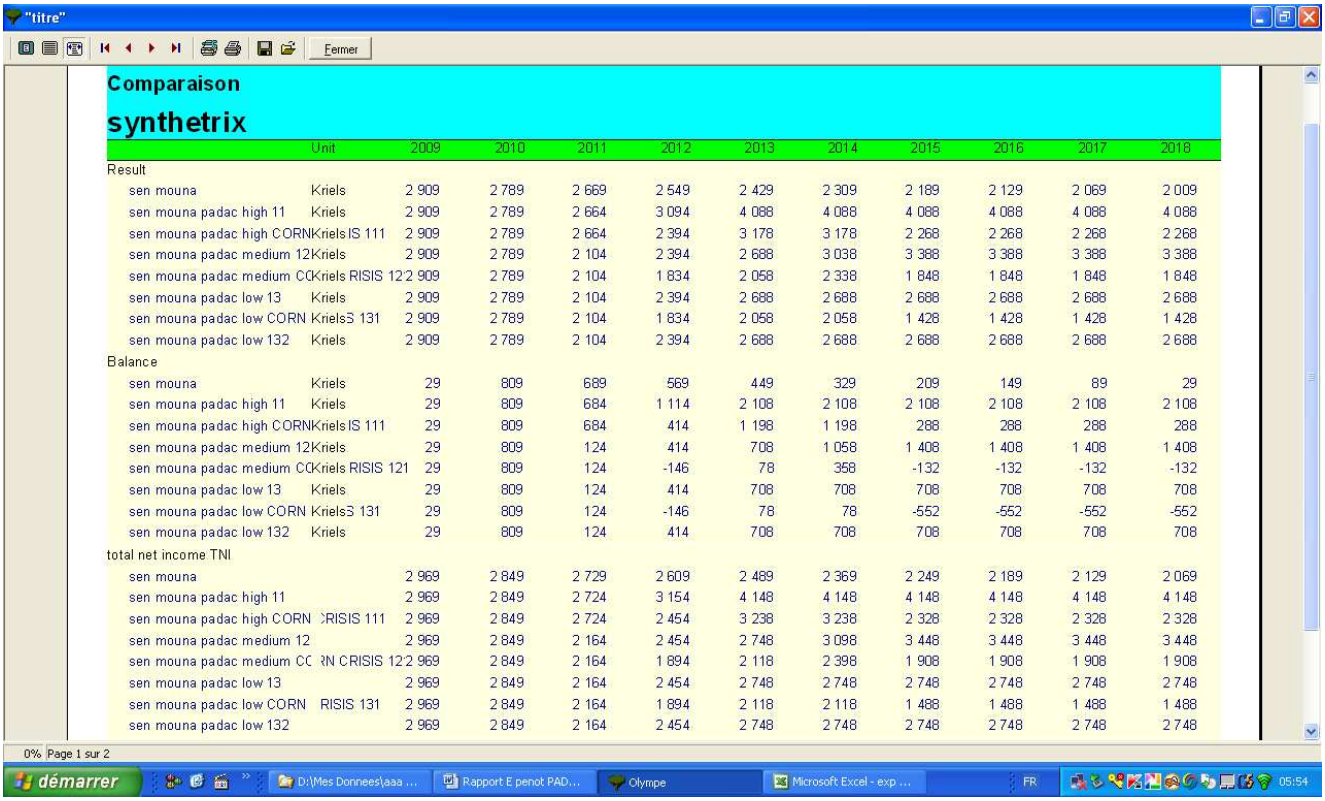
Table 10 : comparison between farmers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Comparaison

synthetrix

	Unit	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Result											
sen mouna	Kriels	2 909	2 789	2 669	2 549	2 429	2 309	2 189	2 129	2 069	2 009
sen mouna padac high 11	Kriels	2 909	2 789	2 664	3 094	4 088	4 088	4 088	4 088	4 088	4 088
sen mouna padac high CORN	Kriels IS 111	2 909	2 789	2 664	2 394	3 178	3 178	2 268	2 268	2 268	2 268
sen mouna padac medium 12	Kriels	2 909	2 789	2 104	2 394	2 688	3 038	3 388	3 388	3 388	3 388
sen mouna padac medium CC	Kriels RISIS 12	2 909	2 789	2 104	1 834	2 058	2 338	1 848	1 848	1 848	1 848
sen mouna padac low 13	Kriels	2 909	2 789	2 104	2 394	2 688	2 688	2 688	2 688	2 688	2 688
sen mouna padac low CORN	Kriels S 131	2 909	2 789	2 104	1 834	2 058	2 058	1 428	1 428	1 428	1 428
sen mouna padac low 132	Kriels	2 909	2 789	2 104	2 394	2 688	2 688	2 688	2 688	2 688	2 688
Balance											
sen mouna	Kriels	29	809	689	569	449	329	209	149	89	29
sen mouna padac high 11	Kriels	29	809	684	1 114	2 108	2 108	2 108	2 108	2 108	2 108
sen mouna padac high CORN	Kriels IS 111	29	809	684	414	1 198	1 198	288	288	288	288
sen mouna padac medium 12	Kriels	29	809	124	414	708	1 058	1 408	1 408	1 408	1 408
sen mouna padac medium CC	Kriels RISIS 121	29	809	124	-146	78	358	-132	-132	-132	-132
sen mouna padac low 13	Kriels	29	809	124	414	708	708	708	708	708	708
sen mouna padac low CORN	Kriels S 131	29	809	124	-146	78	78	-552	-552	-552	-552
sen mouna padac low 132	Kriels	29	809	124	414	708	708	708	708	708	708
total net income TNI											
sen mouna		2 969	2 849	2 729	2 609	2 489	2 369	2 249	2 189	2 129	2 069
sen mouna padac high 11		2 969	2 849	2 724	3 154	4 148	4 148	4 148	4 148	4 148	4 148
sen mouna padac high CORN	'RISIS 111	2 969	2 849	2 724	2 454	3 238	3 238	2 328	2 328	2 328	2 328
sen mouna padac medium 12		2 969	2 849	2 164	2 454	2 748	3 098	3 448	3 448	3 448	3 448
sen mouna padac medium CC	'N CRISIS 12	2 969	2 849	2 164	1 894	2 118	2 398	1 908	1 908	1 908	1 908
sen mouna padac low 13		2 969	2 849	2 164	2 454	2 748	2 748	2 748	2 748	2 748	2 748
sen mouna padac low CORN	RISIS 131	2 969	2 849	2 164	1 894	2 118	2 118	1 488	1 488	1 488	1 488
sen mouna padac low 132		2 969	2 849	2 164	2 454	2 748	2 748	2 748	2 748	2 748	2 748

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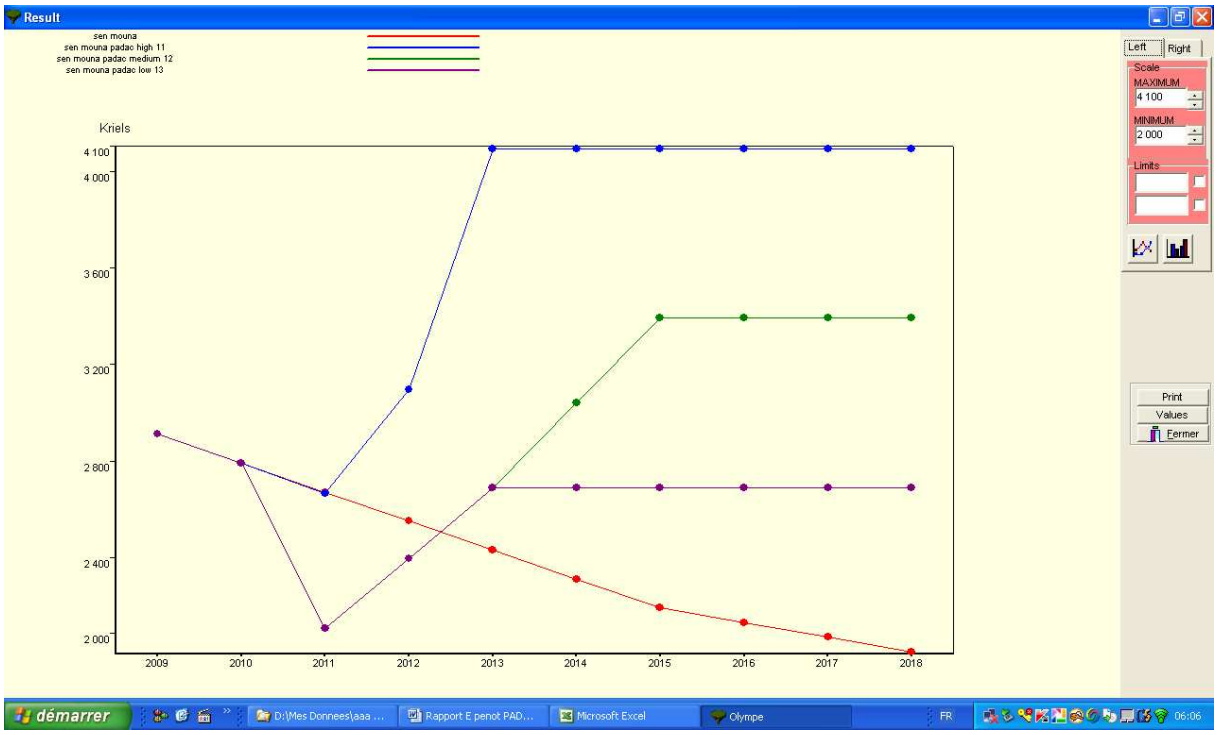
One of the main component of Olympe is to create “variant farms” from an “original farm” of the FSRMN and change the structure of production by suggesting any change such as a new cropping pattern.

In the following example: the farmer “Sen Mouna” (Boribo village) has only 1 hectare of chamcar (upland) and red corn yield decrease every year. We suggest 3 variants with CA adoption in 2011 with 3 level of success: high, medium and low (according to expected corn yield). Details on CA cropping patterns are available in the annex 5.

The result (NAI) evolution will be the following:

Figure 9 : NAI/result evolution according to different CA cropping patterns types

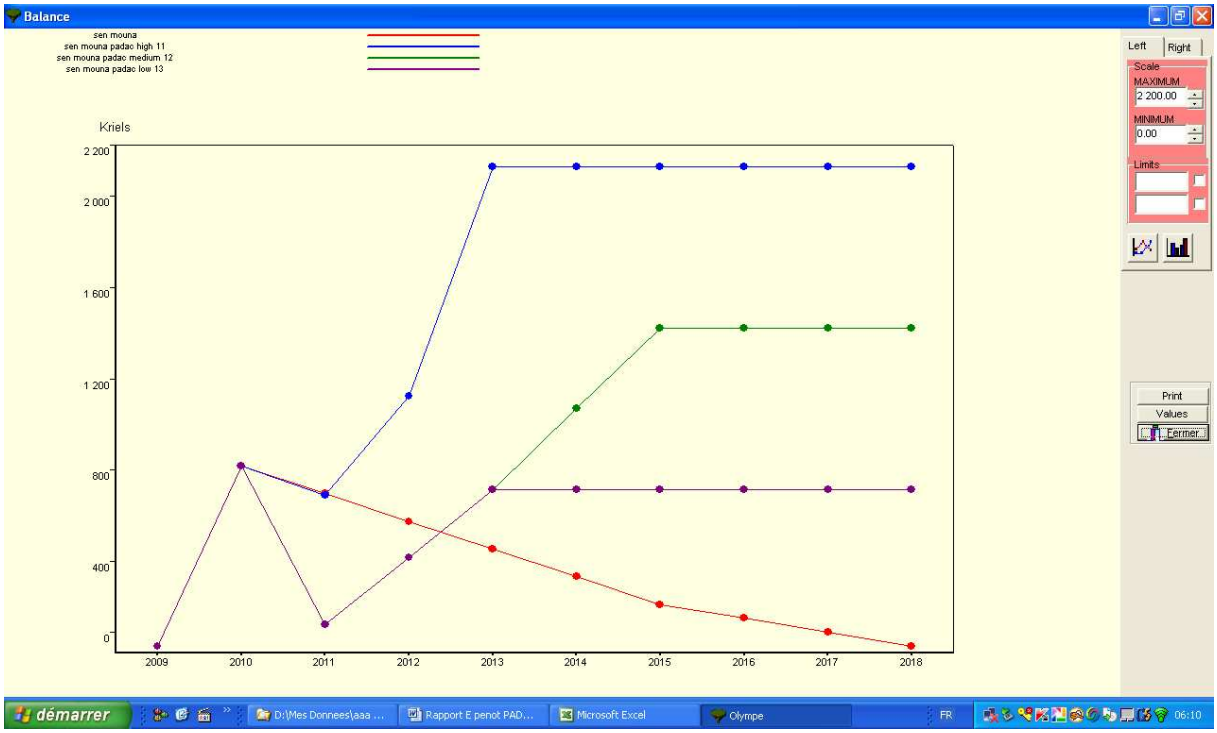


Red = original farm with red corn yield decreasing trend
Purple : CA adoption with low results
Green : CA adoption with medium results
Blue = CA adoption with high results

The figure suggests that the first 2 years might be difficult in terms of investment as green and purple lines are below the red line (normal situation without any change). But very soon, CA adoption is expected to significantly improved both income (NAI) and sustainability in production

The figure 10 displays balance evolution.

Figure 10 : balance evolution according to different CA cropping patterns types



The figure suggests that balance in normal situation without any change will reach ZERO after 10 years. CA adoption is expected to reverse the situation.

A sensibility analysis can e implemented in order to test climatic or price volatility risks.
In the following example, a “hazard” trend has been created to test the impact of a red corn price decrease of 20 % in 2012 and 40 % in 2015.

Figure 11 : creation of a red corn price trend using the module “hazard”

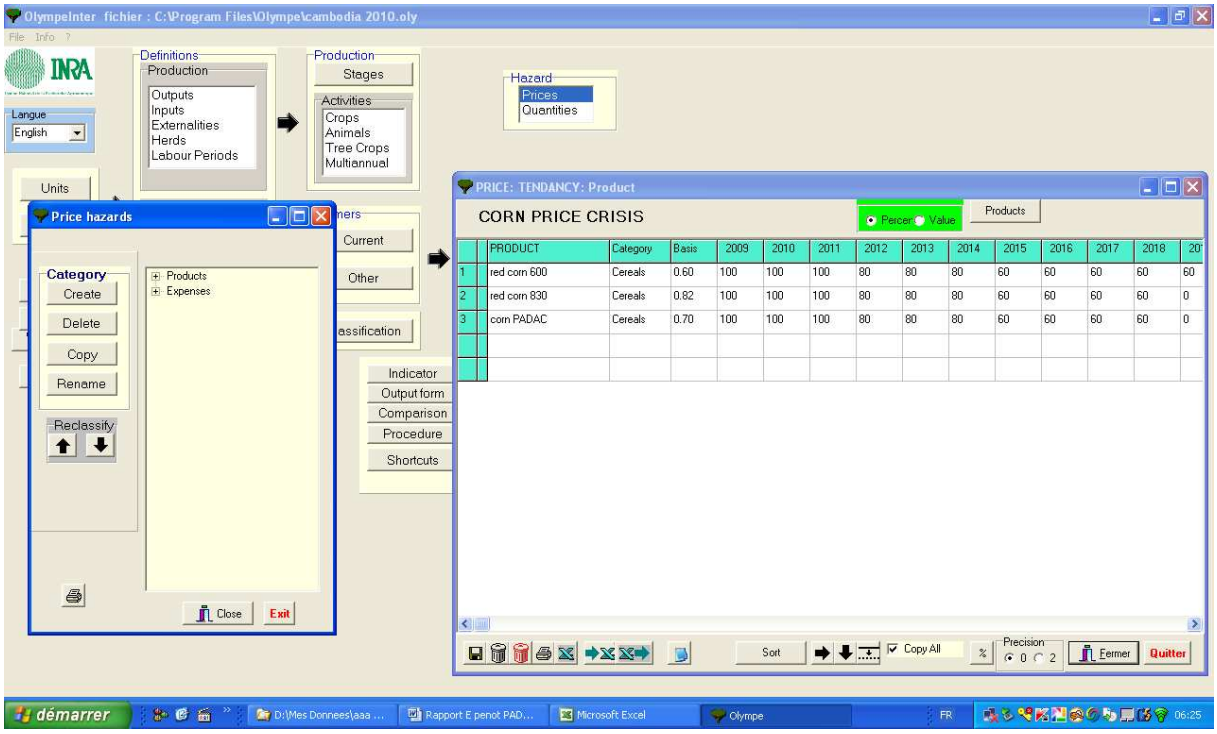


Figure 12 : Impact of a red corn decreasing price trend on result/NAI for Sen Muna farmers without any change

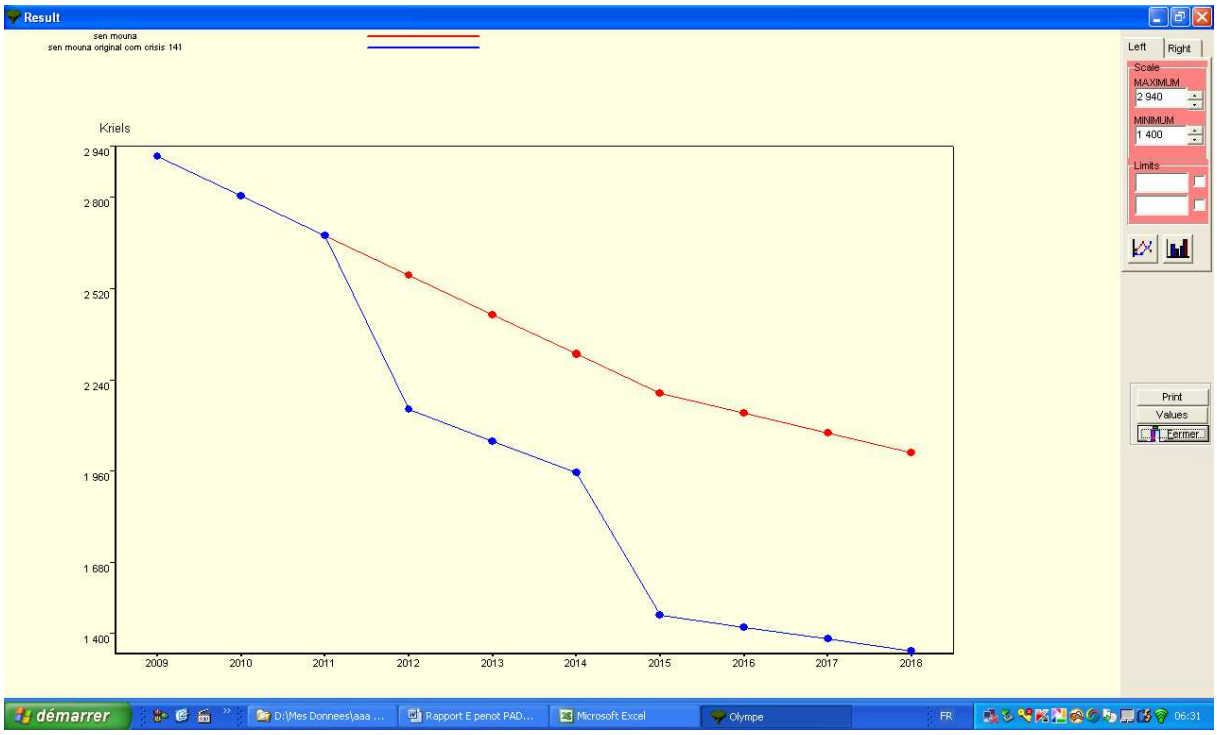
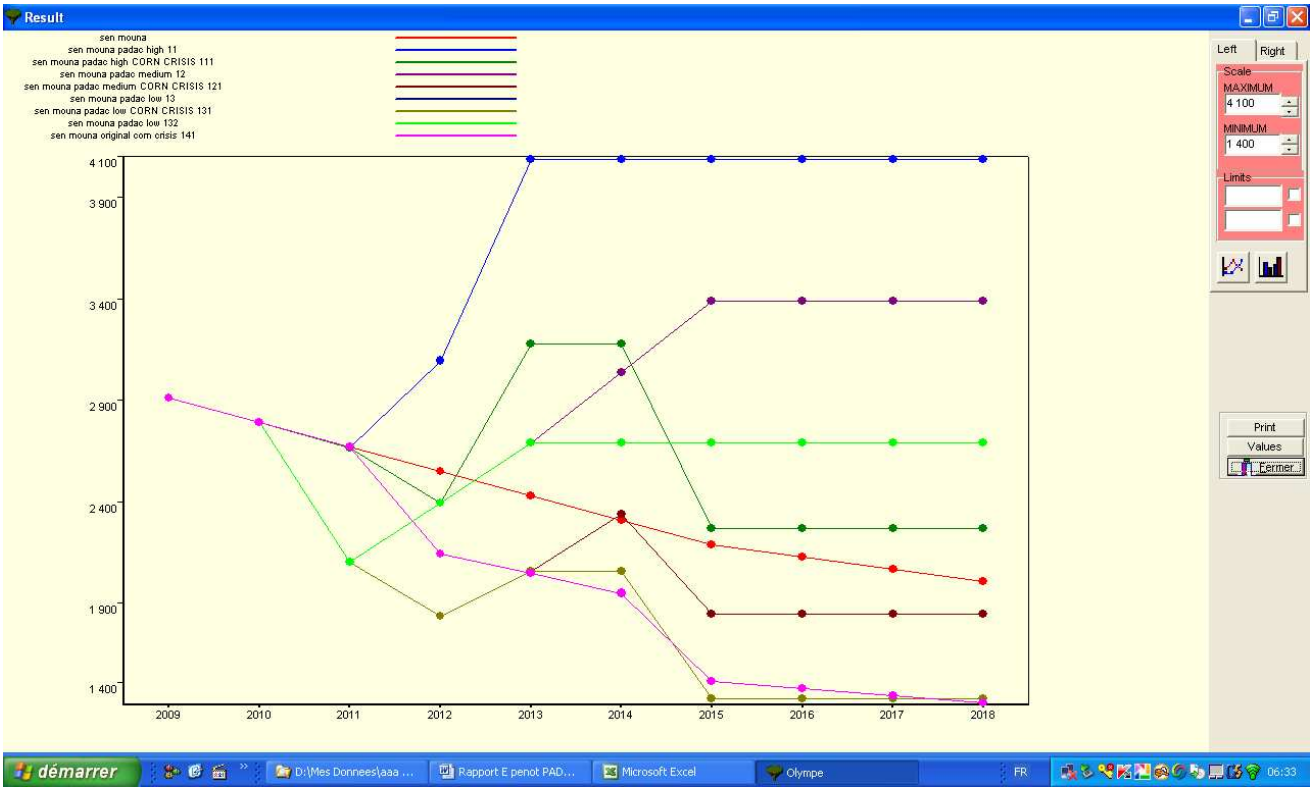


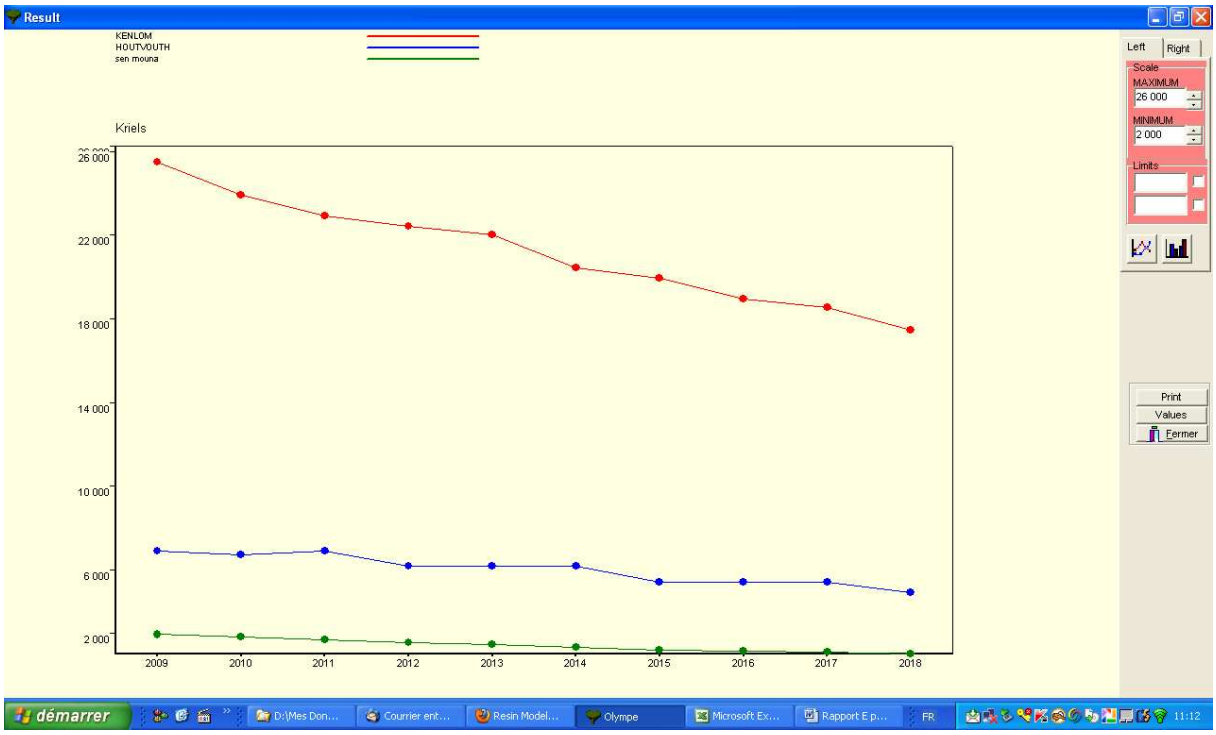
Figure 13: Impact of a red corn decreasing price trend on result/NAI for Sen Muna farmers with CA adoption a 3 levels



The figure displays all range of income (NAI/result) evolution according to technical choice and impact of product price volatility. Of course, all range of "hazards" can be tested.

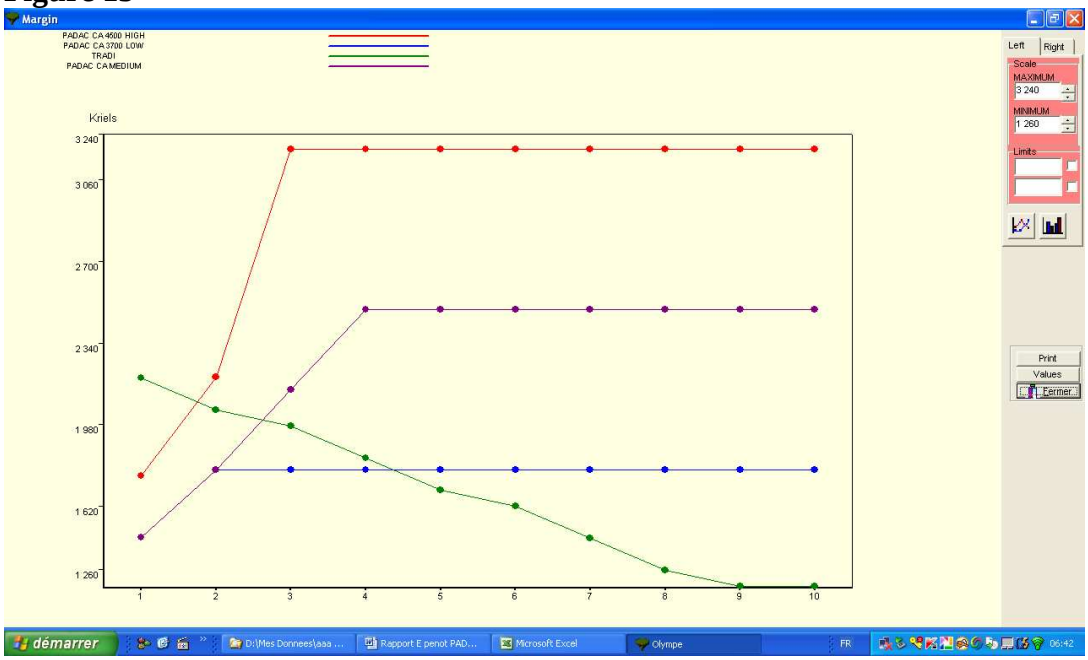
Figure 14 displays the income evolution for the 3 farmers, a decrease trend due to decrease of yield and sol fertility (from 4 to 2;5 t/ha in 10 years time).

Figure 14: Result (NAI) evolution for the next 10 years for the 3 farmers



The margin for each traditional and CA cropping pattern is displaed in the following figure 15:

Figure 15



Conclusion

The methodology for the various surveys to be implemented have been well identified.

The village surveys have been done. Farming systems survey will be implemented soon after the mission. Next step is typology identification.

An olympe file with all indicators and variables required has been provided to the students and a specific training on olympe has been done in order for the 2 students to know exactly what is necessary to collect, type of data , qualitative information on strategies etc ….

Some examples of very simple data analysis is provided in chapter 9 to illustrate the approach.

Annexes

Annexe 1

PROGRAM OF THE TRAINING SESSION

Cambodian Agriculture Laboratory of General Directorate of Agriculture (GDA)
May 14th - 29th 2010

Monday 17th May 2010

AM (8-12h)
Identification of potential needs of all participants.
Proposal for farming system budget analisys
Introduction to Olympe

PM (14-17H)
Olympe

Tuesday 18th May 2010

AM (8-12h)
Olympe

PM (14-17H)
Prospective analysis at farm level : how to define scenarios
The use of the "hazard module"

Wednesday 19th May 2010

AM (8-12h)
How to customize Olympe
Ratios and budget simulation

PM (14-17H)
How to asses risks
Robusteness and resilience

Thursday 20th May 2010

AM (8-12h)
Other potential questions and global approach.

Annexe 2

PROPOSITION DE PROGRAMME DE MISSION AU CAMBODGE

Eric Penot : 15 au 29 mai 2009

Date	**Lieu**	**Programme**
Samedi 15 mai	Phnom Penh	ArrivéeTG 580 (BKKPNH HK1) 0905
Matinée	Phnom Penh	Transfert hotel
Après-midi	Phnom Penh (MAFF)	Discussion cellule du projet
Dimanche 16 mai	Phnom Penh (MAFF)	Formation théorique / inititation OLYMPE
Lundi 17 mai	Phnom Penh (MAFF)	Formation théorique / inititation OLYMPE
Mardi 18 mai	Phnom Penh (MAFF)	Formation théorique / Niveau 2
Mercredi 19 mai	Phnom Penh (MAFF)	Formation théorique / Niveau 2
Jeudi 20 mai	Phnom Penh (MAFF)	Formation théorique / Niveau 2
Vendredi 21 mai		
Matinée	Battambang	Transfert
Après-midi	Battambang	Présentation du projet et des partenaires
Samedi 22 mai	Ratanakmundul	Tour de plaine / visites parcelles SCV/entretiens personnes ressources
Dimanche 23 mai	Ratanakmundul	Enquêtes exploitations agricoles (village de Boribo)
Lundi 24 mai	Ratanakmundul	Enquêtes exploitations agricoles (village de Petchangva)
Mardi 25 mai	Ratanakmundul	Enquête "gender issue"
Mercredi 26 mai		
Matinée	Phnom Penh (MAFF)	Transfert
Après-midi	Phnom Penh (MAFF)	Configuration base de données
Jeudi 27 mai	Phnom Penh (MAFF)	Présentation au CARD
Vendedi 28 mai		
Matinée	Phnom Penh (MAFF)	Configuration base de données
Après-midi	Phnom Penh	Synthèse de la mission AFD (15 H)
Samedi 29 mai		
Matinée	Phnom Penh	Bilan stagiaires SANREM
Après-midi	Phnom Penh	Discussions cellule du projet
Soir	Aéroport	TG 581 (PNHBKK HK1) 1805

Contacts :

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Stéphane Chabierski: (855) 012 657 874

Annexe 3

Proposition de stage au Cambodge, 2009

Diagnostic agraire et caractérisation des exploitations agricoles avec pour objectif la mise en place d'un réseau de fermes de références

Projet d'Appui au Développement de l'Agriculture du Cambodge (CIRAD/AFD/MAFP)

CIRAD. Le stage sera co-encadré par S. Boulakia, S. Chabierski (CIRAD-PERSYST, UPR1 SCV) et E. Penot (CIRAD-ES, UMR Innovation)

Pays : Cambodge

Cadre : projet de développement PADAC (Projet d'Appui au Développement de l'Agriculture du Cambodge), financé par l'Agence Française de Développement
Période : Mars-mai à août-septembre 2010 (SUPAGRO-IRC, option AGIR)

1. Contexte

Le Cambodge a une population totale d'environ 13.8 millions d'habitants, dont 85% vivent en milieu rural. Si l'agriculture khmère a traversé les siècles sans grande transformation, cette époque paraît désormais bien révolue. La croissance de la population est telle que les milieux historiquement les plus cultivés sont désormais parvenus à saturation démographique. L'ouverture au marché et l'attrait des nouveaux modes de consommation incitent également à une remise en cause des modes de production.

Dans le cadre de leur politique de soutien à la diversification et à l'intensification des productions agricoles sur les principaux milieux cultivés du Royaume, les autorités cambodgiennes ont décidé la réalisation d'un Projet d'Appui au Développement de l'Agriculture du Cambodge (PADAC). Ce projet, financé par l'AFD et dont la maîtrise d'oeuvre a été déléguée par le MAFP au CIRAD, prolonge les actions initiées à des échelles de « Recherche&Développement » par la composante « diversification des systèmes de culture & SCV » du Projet de développement de l'Hévéaculture Familiale (PHF, mis en œuvre entre Octobre 2003 et Juin 2008). Cette première phase a notamment permis la mise au point de systèmes de culture SCV (Semis direct sur Couverture Végétale) sur 2 grands agro-écosystèmes représentants des enjeux majeurs pour l'agriculture du Cambodge : les cultures pluviales exondées et les anciennes terrasses « alluvio - colluviales », support d'une riziculture inondée pluviale d'autosubsistance. Les gains générés par rapports aux pratiques paysannes locales oscillent entre 200 et 400 $/ha, selon les systèmes considérés. La validation et l'amélioration de ces itinéraires techniques au travers d'une étape de diffusion à des échelles pilotes significatives constitue un des principaux objectifs du projet actuellement.

Afin de proposer des solutions adaptées aux agriculteurs des villages pilotes échantillonnés en 2008 dans la province de Kampong Cham, les responsables du projet souhaitent affiner le diagnostic agro-socio-économique réalisé en 2004 et mettre en place un système de suivi évaluation de qualité. Dans ce cadre, la présente étude visera à (1) élaborer une typologie régionale des exploitations agricoles et (2) à mettre en place un réseau de fermes de références. Elle est liée à la réalisation d'une mission d'appui de l'expert agro-économiste Eric Penot, basé à Madagascar (mai 2009).

2. Conditions générales

Cette étude sera réalisée par deux binômes franco-cambodgiens. Pour ces deux stages identiques, le CIRAD et le projet prennent en charge :

- Une indemnité de 400 euros /mois, à hauteur de 4 mois soit 1600 euros
- L'hébergement, le fonctionnement sur place et les déplacements intra-cambodge
- L'assurance rapatriement.

Contacts : S. Boulakia (stephane.boulakia@cirad.fr), S. Chabierski (stephane.chabierski@cirad.fr) et Eric Penot (eric.penot@cirad.fr)

3. Sujet : Analyse des systèmes de production de la zone d'intervention du Projet avec identification d'une typologie et modélisation des exploitations agricoles pour la mise en place d'un réseau de fermes de références.

Thème de l'étude :

- **description et diagnostic des systèmes de productions** (analyse systémique classique)
- identification d'**une typologie opérationnelle en vue de la mise en place d'un réseau de fermes de référence**
- analyse contraintes-opportunités
- position de "l'offre" du projet PADAC/ résultats issus de l'enquête de caractérisation des exploitations agricoles et de l'identification des stratégies paysannes
- analyse des évolutions en cours : facteurs d'évolutions, dynamiques des exploitations agricoles, migrations, formes d'accumulation...
- influences des marchés
- **identification et mise en place d'un réseau de fermes de références** (sélection des fermes représentatives par type en fonction de la typologie)
- **modélisation des exploitations agricoles du réseau avec le logiciel OLYMPE.**

Chaque binôme d'étudiants enquêtera 60 exploitations, dont une trentaine seront modélisées.

Les enquêtes seront obligatoirement traitées avec les logiciels Winstat ou Excel (la connaissance des tableaux dynamiques est souhaitée) et la modélisation technico-économique sera réalisée avec le logiciel Olympe (formation assurée par E Penot au mois de mai 2009).

Annex 4
Questionnaires

4.1 Guide d'entretien pour les enquêtes villageoises

Le village

1. Zone : Nom du village : Localisation : Chef du village :
2. Accessibilité : distance par rapport à Phnom Penh ou à la ville principale (Kompong Cham) ?
3. Etat de la piste d'accès du village :
4. Nombre de familles en 75 (ou avant si nécessaire), 79, actu :
5. Nombre d'exploitations agricoles :
6. Y a-t-il encore des terres disponibles dans le village ? Pourquoi ? (terres incultes, forêt sacrée, etc.)
7. Niveau de saturation du foncier :
    - Au niveau du finage villageois
    - Au niveau des exploitations agricoles (utilisation de tout le capital foncier d'une famille par la SAU)

Caractérisation des sols

8. Quels sont les différents types de sols ? Quel nom vernaculaire donne-t-on à chaque type ?
9. Distribution des zones morpho-pédologiques du village (accès aux chamcars et aux rizières)
10. Quels sont les différents types de rizière ? Y a-t-il un système de gestion de l'eau ou un réservoir d'eau ?
    - A irrigation contrôlée
    - A irrigation +/- contrôlée
    - Inondée
    - Inondable
    - Champs de riz pluvial
11. Qui a accès aux rizières ?
12. Quels sont les différents niveaux de fertilité ?
    - 3 niveaux pour les terres rouges
    - 2 niveaux pour les terres noires
    - Les terres sableuses

Les systèmes de culture

13. Quelles sont les principales productions végétales ? Riz pluvial de plateau, rizière inondée (1 ou 2 cycles/an ?), sésame/haricot//soja, maïs, arachide, cultures maraîchères, manioc, canne à sucre, bananiers, ananas, hévéas, anacardiers, mandariniers, poivriers, SAF (durian, aréquier, ramboutan, jaquier, manguier), jardin de case, pomme cannelier, frangipanier, etc.

14. Productions végétales	15. Importance (en termes de surface)
16.	17.
18.	19.
20.	21.

22. Quand sont apparues les différentes cultures ? (anacardier, bananier…) : dynamique et historique (apparition, disparition).
23. Expliquer le choix de changement de culture ? (prix, rendement, coût de la main d'œuvre, coût des intrants, accès au marché, etc.)
24. Identifier les réseaux d'acteurs (adoption d'une nouvelle culture, changement d'ITK, partage des savoir-faire, etc.)
25. Quelle variété de manioc est cultivée ? Pourquoi ?
26. Quels sont les rendements pour chaque culture ?
27. Quelle évolution des rendements ? (sur 10 ans)
28. Au bout de combien d'années, la terre se dégrade-t-elle ? (un changement de culture est une indication à une baisse de fertilité des sols)
29. La culture de premier cycle est-elle importante ? Quelle évolution des rendements ?
30. Quelle pression des adventices ?
31. Perception des variations climatiques ?
32. Importance du jardin de case ? Apporte-t-il un revenu important à la famille ? Vente d'aréquier ? A quel prix ? Modalité de vente ?

Les systèmes d'élevage

33. Quelles sont les principales productions animales ? (buffles, zébus, porcs, volaille)
34. Distinguer le capital sur pied de l'atelier d'élevage (engraissement) et de la mécanisation animale.

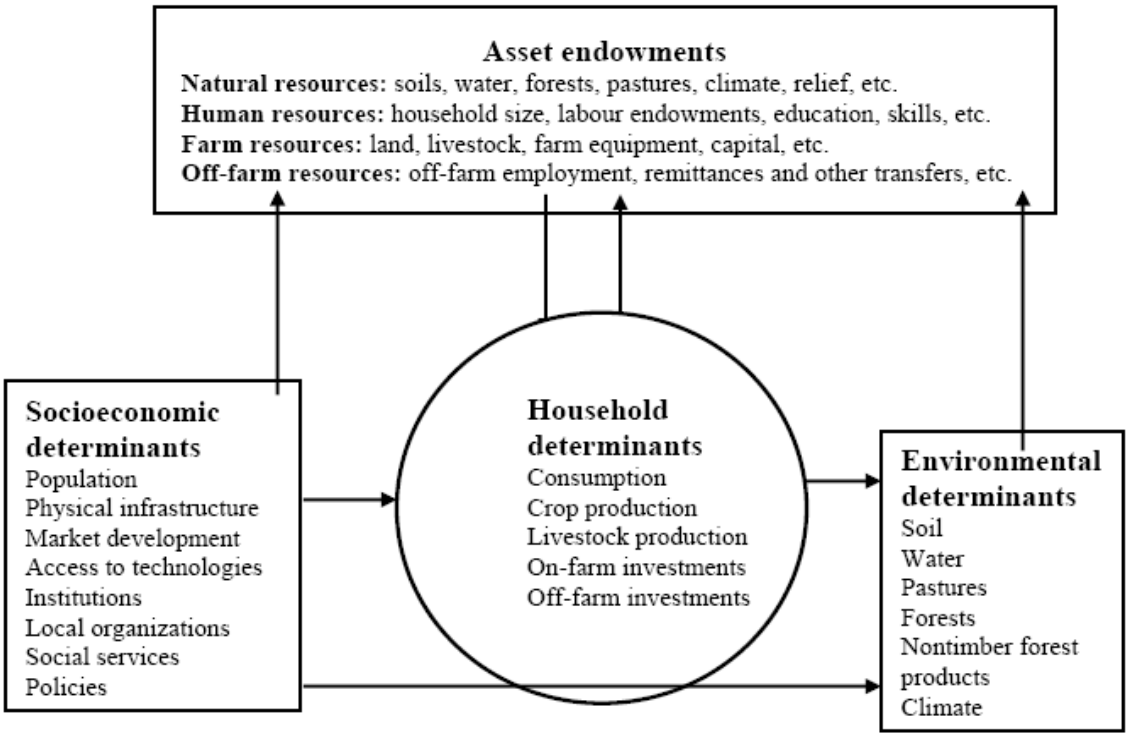
35. Alimentation des animaux ?
36. A quel moment les ventes ont-elles lieu ?

Contexte socio-économique

37. Prix de la main d'œuvre en fonction des différents travaux / tâches ?
38. Evolution du prix de la main d'œuvre ?
39. Evolution du prix des intrants ? Quelle utilisation d'intrants et pour quelle culture en priorité ?
40. Si il y a une augmentation du prix de la main d'œuvre et si le prix du manioc reste le même, que vont-ils faire ?
41. Y a-t-il des vols dans le village ? Ressentent-ils de l'insécurité ?
42. Y a-t-il une activité de transformation dans le village ? (ex : fabrication de vin de riz, de vin de palmier, artisanat)
43. Marché important à proximité : (locaux, nationaux et export)
44. Qui a accès aux marchés ? Quels sont les différents acteurs des filières ?
45. Qui achète la production (traders venant au village, vente sur pied, marché de grés à grés (le commerçant négocie avec chaque paysan un par un, il n'y a pas de regroupement des agriculteurs) ou vente au marché le plus proche ?) Quelles sont les différences de prix ?

46. Modalités de ventes et de transport des productions ? Quel est le coût du transport des marchandises (du bord de champ à la maison, de la maison au marché) ?
47. Quels sont les précédents et actuels projets de développement agricole ?
48. Autres types de projet (non agricole : commercialisation, équipement…) :
49. Part des activités off farm dans le revenu des familles ? Quels types d'activité off farm ?
50. Y a –t-il de la pêche ? de la cueillette ? de la récolte de miel ?
51. Scolarisation des enfants : A quel âge sont-ils scolarisés et jusqu'à quel âge ? L'école est-elle éloignée du village ? Quel est le coût de la scolarisation ? (tous frais compris) Quel pourcentage d'enfants est scolarisé ?
52. Identifier la périodisation
53. Identifier les principaux systèmes d'innovations
54. Identifier les principales contraintes et opportunités pour le production agricole
55. Identifier les principales sources de savoirs

Schéma sur les liens entre ressources, exploitation, accès aux services et environnement



	Ce que l'on cherche à savoir…	Question à poser
Histoire	Quels sont les déterminants de la situation agraire actuelle ? Hypothèse sur évolution future ?	Date de création du village ? Situation avant guerre (1970) ? - organisation sociale - nombre d'agriculteurs - principales productions - surfaces en hévéa, - localisation hévéa Evolution pendant les différentes périodes ? (1970-75, 1975-77, 1977-79, depuis 1979...) Déplacement de population, migrations, solde migratoire (positif ou négatif) Evolution future en terme de production, d'infrastructure, de projets, d'organisation sociale et des producteurs
Foncier	Dynamique foncière propriété, fermage, métayage modalités de faire valoir de la terre	Coût de la terre (vente et location : le marché) en fonction de la localisation et de l'utilisation? Facilité d'accès au foncier ? Mode de tenure foncière ? propriété, métayage, fermage, colonage… Partage des terres : date et modalités ? Immigration ? Dans quelles conditions ? Quelles terres d'accueil ?
Travail	Caractéristiques de la MO : familiale et salariée	Entraide villageoise ? type, modalités, pour quels travaux ? Existe-t-il des EA qui n'emploient pas de MO extérieure ? Origine de la MO extérieure (village, extérieur)?
Capital	Formes de capitalisation Accès au crédit	Mode d'accès au crédit Compte bancaire ? Matériel agricole, décortiqueuse…. Equipement en commun ? type de gestion ? Modes de transmission du patrimoine (où vont les enfants n'héritant pas des terres ?) Forme de capitalisation (amélioration des conditions de vie (maison, éducation des enfants, loisirs), plantations, élevage, foncier…), ordre de priorité ?

Culture de l'hévéa	Les déterminants pour l'adoption et la culture de l'hévéa ? Impact du projet AFD ? Différence entre EA du projet et EA hors projet. Modalités de mise en place des plantations hors projet Description, mise en place et gestion d'une plantation Stratégie des agriculteurs concernant l'hévéa : place de l'hévéa par rapport aux autres productions	Atouts et contraintes de l'hévéa Mode de commercialisation ? Débouchés : privés ou étatique ? Prix de vente ? Organisation villageoise pour collecte et livraison ? Caractérisation de la MO utilisée: niveau de formation, origine, type de rémunération… Evolution des prix du caoutchouc (latex, fonds de tasse ….) Description des itinéraires techniques (clone, mode de saignée, stimulation, type de sol…, Culture en intercalaire, Précédent cultural Coût de mise en place d'1 ha en période immature Coût de production en période mature Intrants : type, quantité, prix, mode d'accès, modalités d'utilisation … Histoire de l'hévéaculture dans le village (date introduction, surfaces, période 70-75, période 75-79, de 79 à aujourd'hui…)
Riziculture	Les différents itinéraires techniques les déterminants de la variation des rendements ?	Description de l'ITK (sol, intrants, pépinière, mode de gestion de l'eau, variétés…) Rendement. Destination de la production : autoconsommation ou vente ? Prix de vente ? évolution, variation annuelle Comment l'aménagement pour le passage à la double culture s'est-il fait ?
Jardin de case		Espèces Quantité devenir (autoconsommation, vente…) prix de vente
Système agroforêstier		Principales espèces Type de gestion (en commun…) Devenir des différentes productions Prix des différents produits
Autres productions	Principaux itinéraires techniques	Description Localisation Cultures pérennes autres que hévéa: anacardier, arbres fruitiers Cultures annuelles : sésame, haricot, soja, arachide, maïs, légumes… Pluriannuelles : canne a sucre, ananas, banane, manioc. Distance par rapport à l'habitat ?
Elevage	Types d'élevage	Bovins / zébus: Distribution et nombre par famille des bovins Utilisation : trait, capitalisation, gardiennage, transport Mode de conduite : Mode de faire valoir : métayage… Problème de maladie (bovins, porcins, volailles) ?

Organisation sociale du village	Modes de structuration Les règles coutumières Identification des réseaux Cohérence système social/système technique	Associations de villages Association de producteurs Calendrier religieux, fête de villages à quelles occasions… ? Entraide, dons, réciprocité de MO…. Liens familiaux ou claniques au sein du village (dont emprunts et nantissement des emprunts) ? Réseaux (de commercialisation Organisation pour aménagements (drainage, irrigation…)
Atouts et contraintes	Les principaux besoins des agriculteurs ? Les éventuels freins au développement agricole ?	Atouts et contraintes environnementales, commerciales, politiques, socio-économiques… ? Ordre d'importance des problèmes ? Situation par rapport aux autres villages. Effet situation du village Histoire et prospective Décisions collectives et/ou individuelles…Influence sur les « stratégies » des paysans ?

4.2 **Focus Group Itinerary for Working with a SANREM Research Site Community**

Total: 6 hours 40 minutes

Timing	**Discussion Format**	**Activity Description**	**Prompt Questions**	**Data Collected**
20 minutes	K Moore ME Christie	Blessing, Welcome, Introductions Overview of SANREM research project, voluntary participation, Outline of the day, Rules of the Game Recorders and notebooks for each group	Old and young, women and men This is a research project: We are here to learn from you and help you learn about how to create options to improve your production systems. How would you improve your agricultural production systems?	Sign in & general information about the participants
30 minutes	Full Group Activity	**Resource Generator Activity/Access to Assets:** Ask group what resources are necessary for agricultural production including material and information	What is a resource? What resources do you use to produce staple food crops in this community?	List of resources for inclusion in the position generator survey instrument
5 minutes	Full Group	**Explain Focus Group Activity: Men and Women** Practices and Participation	What information do you need for production?	
45 minutes	Focus Group Work	**Practices and Participation Activity:** What are the activities and roles of men and women in different phases of the production and reproduction process?	Who does what, where & when? a list of activities	List of gendered ag production activities , opportunities and constraints
5 minutes	Reconvene	Direct men and women's groups back for full discussion		
30 minutes	Full Group Discussion	**Practices and Participation** Women present for 10 minutes	How do roles complement each other? What are shared activities?	Refined qualitative data

Timing	Discussion Format	Activity Description	Prompt Questions	Data Collected
		Men present for 10 minutes Discuss differences for 10 minutes		
20 minutes	Break	Light snacks		
5 minutes	Full Group	**Explain Focus Group Activity: Men and Women** Gendered maps		
45 minutes	Focus Groups Work	**Gendered Maps:** Map resources and actors involved during agricultural production, have groups designate by gender access to and control of these resources	What are the actors, places and spaces resources are accessed? Who has access to certain resources? Who are the people interacted with during production?	Maps for gender comparison, confirmation of actors to be included in the larger survey
5 minutes	Reconvene	Direct men and women's groups back for full discussion		
40 minutes	Full Group Discussion	**Gendered Maps** Men present for 10 minutes Women present for 10 minutes Discuss differences for 20 minutes	Why do the maps look the way they do? What differences between the maps do the groups see as significant?	Refined maps
60 minutes	**Lunch**	Allow participants to socialize, set up for the timeline and soil perceptions activities.		
5 minutes	Full Group	**Introduce and explain activities:** Actor Timeline	Has production always been this way?	
30 minutes	Focus groups Work	**Timeline:** Ask groups to develop a timeline for staple crop production. How has crop production changed? What were the influential events? Who were the influential people?	How was it when the oldest among you were growing up? How is it now? What changed? When and why?	Timelines for comparison across genders, context of actor relationships; cohort effects
5 minutes	Reconvene	Direct men and women's groups back for full discussion		

Timing	Discussion Format	Activity Description	Prompt Questions	Data Collected
5 minutes	Full Group	**Introduce and explain activities:** Soil perceptions exercise. Describe the soils and pictures		
30 minutes	Focus Group Work	**Soil Perceptions exercise:** Give the groups five minutes to examine the different soil types and classify them. Ask them to explain what is occurring in the picture.	Describe the picture. What is the condition of the soils? Who/what is responsible?	Qualitative data on attitudes and perceptions of groundcover and production systems
5 minutes	Reconvene	Direct men and women's groups back for full discussion		
30 minutes 30 minutes 20 minutes	Full Group Discussion	**Timelines:** Women present for 10 minutes Men present for 10 minutes Discuss differences for 10 minutes **Picture activity:** Women present for 10 minutes Men present for 10 minutes Discuss differences for 10 minutes **Closing discussion and feedback:** What was most interesting? Did anything surprise you? How will ideas carry forward? Discussion of future SANREM project work	What are the differences in the timelines? Were different things significant to the different groups? Were the attitudes similar or different in the gendered groups?	Refined timeline qualitative data Refined perceptions qualitative data

Annexe 4.3 : Guide d'entretien pour les enquêtes individuelles en vue d'une analyse des systèmes d'exploitation de Battambang

Situation familiale

1. Date :
2. Nom de l'exploitant
3. Code
4. Sexe du chef d'exploitation
5. Age du chef d'exploitation
6. Situation familiale du chef d'exploitation (célibataire, marié, veuf, divorcé). Combien de personnes vivent sous le même toit ? Décrire les membres de la famille (nombre, âge, situation familial, scolarisation des enfants et niveau d'étude…)
7. How many household members are working in the farm? Identify by gender:
   Female_____ Male_____

   Who generally works in the farm? _____(adult males/females, young males/females)
8. Fonctions sociales (politiques, religieuses, militaires)
9. Pour quelles raisons (intérêts économiques, pouvoir moral, prestige)

Localisation du siège de l'exploitation

10. Province
11. District
12. Commune
13. Village

Autres renseignements généraux

14. Accès au marché
15. Historique d'installation : Date de l'installation ? Pour quelles raisons ? Quelle surface possédée à l'installation ? Et aujourd'hui ? Type de succession prévue ? A-t-il déjà cédé une partie de ses terres à ses enfants ?
16. Déplacement de la famille ces 15 dernières années
17. Type de maison (matériaux de construction, taille…)

Main d'œuvre

18. Nombre de personnes vivant et mangeant ensemble ?
19. Nombre d'adultes, > 15 ans, dans la famille ? et travaillant sur l'EA ?
20. Nombre d'enfants, < 15 ans, dans la famille ?
21. Nombre d'actifs dans la famille ? Que font-ils ? (travail in farm ou off farm ?)
22. Emploi de MO extérieure, permanente ou temporaire ? (ex : gardien pour les plantations de plantes pérennes)
23. Disponibilité de cette main d'œuvre au cours de l'année ? A-t-il besoin d'une MO qualifiée ? Est-elle disponible ?

24. Type de contrat (pour la MO permanente) ou type de rémunération (de la MO temporaire, donner les détails dans les ITK) ? Les salaires versés comprennent-ils les repas du midi ? Si non, coût des repas ?

Capital

25. Matériel agricole (petit matériel, matériel de transport, de transformation, d'irrigation, …)

Matériel	**Coût d'achat**	**Année d'achat**	**Durée de vie**	**Coût entretien (annuel)**

26. Bâtiments

Type	**Coût d'installation**	**Année d'achat**	**Durée de vie**	**Coût entretien (annuel)**

27. Emprunt en cours à vocation agricole et autre (bien distinguer) : utilisation du crédit, organisme de prêt, type de prêteur (banque, famille, crédit du projet ?), durée de l'emprunt, taux d'intérêt, montant de l'annuité

Le foncier

28. Surface totale, SAU

Chamcar	
Rizière 1	
Autres	

29. Mode d'acquisition (quand, comment…) ? soit partage des terres de 1983, soit héritage, soit autre (achats…). Détailler les évolutions des surfaces au fil des années.
30. Achat de terre ? (quand, superficie, coût, pourquoi ?)
31. Terres en fermage : utilisation, coût ?
32. Terres en métayage : utilisation, modalités (taux de répartition) ?
33. Vente de terre (surface, date, coût)
34. Dons aux enfants (surface, date)
35. La superficie actuelle est-elle permet-elle de couvrir les besoins de la famille ?
36. Niveaux de fertilité des terres ?
37. Type de rizière ?

Les Systèmes de culture

Note : Pour les itinéraires techniques : labour, semis, engrais, traitements, sarclage, récolte, transport, transformation, commercialisation, valorisation de sous produits, rendement.

Pour chaque opération, ne pas oublier les temps de travaux, le type de la main d'œuvre, le matériel utilisé.

Les systèmes de cultures pérennes

Système de culture fruitier

38. Surface ?
39. Origine de la ou des plantations (projet ou hors projet) ?
40. Localisation des plantations et raisons du choix du lieu ?
41. Distance par rapport à la maison ?
42. Date de plantation ?
43. Année de première récolte (réelle ou espérée si immature) ?
44. Raisons du choix de cette culture ?
45. Précédent cultural ?
46. Type de sol ?
47. Précédent cultural ?
48. Nom du ou des clones/variétés et répartition ?
49. Provenance des plants si plantation hors projet ?
50. Itinéraire technique:

Opérations Culturales	Date	intrants	Qté intrant	Coût intrant	Matériel utilisé	Tps de travail total	MO Fam.	MO Ext.	prix MO Ext./j
Travail du Sol									
Piquetage									
Trouaison									
Plantation									
Entretien plantation (sarclage)									
Saignée									
Fertilisation en période immature									

51. Existence de problème de maladies ?
52. Exploitation du bois : montant de la vente, coût de l'abattage si différent de vente sur pied, utilisation des revenus issus de la vente du bois ?
53. **Cultures intercalaires** (CI) en période immature : nature et itinéraire technique ?
54. Combien d'année de CI annuelles ?
55. Utilisation des productions des CI annuelles (vente ou autoconsommation) ?
56. Cultures pérennes en période mature : nature, itinéraire technique ?
57. Utilisation des productions des cultures pérennes associées ?
58. Si pas de culture intercalaire (pérennes ou annuelles), pourquoi ?

Jardin de case

59. Superficie
60. Principales productions
61. Association de culture ? Raisons spécifiques des associations ?
62. Estimation du temps de travail ? Achat de matériel spécifique ?
63. Utilisation de la production (autoconsommation, vente) ? Prix et modalités de vente ?

Plantes	Quantité	Utilisation	Prix de vente	Utilisation annexe	Quantité intrants	Prix intrants	Acheteur

Système agro-forestier à base de fruitiers (SAF)

64. Superficie
65. Distance par rapport à la maison ? Type d'accès ?
66. Principales productions ? (cf. tableau ci-dessous)
67. Association de cultures ? Pourquoi

Plantes	Quantité	Utilisation	Prix de vente	Utilisation annexe	Quantité intrants	Prix intrants	Acheteur

Note : tableau établi par ordre d'importance

68. Temps de travaux annuels (récolte, entretien, plantation….)
69. Temps de travaux pour mettre en place un SAF ?
70. Destination de la production (autoconsommation, commercialisation) ? Coût de transport ?
71. Types de cultures annuelles cultivées en intercalaire durant la période immature ?

Systèmes de cultures annuelles

Riziculture inondée

72. Type de rizière ? Accès à la rizière ?
73. Surface
74. Variété utilisée ? Durée du cycle ?
75. Type de sol et localisation selon la topo séquence ?
76. Itinéraire technique :

Opérations Culturales	Date	intrants	Qté intrant	Coût intrant	Matériel utilisé	Tps de travail total	MO Fam.	MO Ext.	prix de la MO Ext./jour

77. Rendement ?
78. Quantité autoconsommée ?
79. Quantité vendue ?
80. Prix de vente ? A quel moment de l'année a lieu la vente?

Note : Si étalement des ventes important et forte variation saisonnière, tableau

81. Utilisation des sous-produits (quantité, prix) : paille ? son ?
82. Coût décorticage ? Moyen de paiement du décorticage ?
83. Coût de transport ?

84. Evolution des rendements sur 10 ans ? Evolution de la fertilité du sol ?
85. Evolution de la pression des adventices ?

Note : ne pas oublier les coûts des sacs et de transport

Riziculture pluviale

86. Type de rizière ? Accès à la rizière ?
87. Surface
88. Variété utilisée ? Durée du cycle ?
89. Type de sol et localisation selon la topo séquence ?
90. Itinéraire technique :

Opérations culturales	Date	intrants	Qté intrant	Coût intrant	Matériel utilisé	Tps de travail total	MO Fam.	MO Ext.	prix de la MO Ext./jour

91. Rendement ?
92. Quantité autoconsommée ?
93. Quantité vendue ?
94. Prix de vente ? A quel moment de l'année a lieu la vente?

Note : Si étalement des ventes important et forte variation saisonnière, tableau

95. Utilisation des sous-produits (quantité, prix) : paille ? son ?
96. Coût décorticage ? Moyen de paiement du décorticage ?
97. Coût de transport ?

98. Evolution des rendements sur 10 ans ? Evolution de la fertilité du sol ?
99. Evolution de la pression des adventices ?

Note : ne pas oublier les coûts des sacs et de transport

Systèmes de culture de premier cycle : sésame, arachide mungbean, mais

100. Accès à la parcelle ?
101. Surface
102. Type de sol et localisation sur la topo séquence ?
103. Type de rotation ?
104. Itinéraire technique :

Opérations culturales	Date	intrants	Qté intrant	Coût intrant	Matériel utilisé	Tps de travail total	MO Fam.	MO Ext.	prix de la MO Ext./jour

105. Production et utilisation :

Plante	Quantité totale produite	Quantité autoconsommée	Quantité vendue	Prix de vente	Acheteur

Note : Si l'étalement des ventes est important et forte variation saisonnière, faire un tableau.

106. Coût de transport ?

107.Evolution des rendements sur 10 ans ? Evolution de la fertilité du sol ?
108.Evolution de la pression des adventices ?

Systèmes de culture de second cycle: mais rouge, canne à sucre, autres

109.Accès à la parcelle ?
110.Surface
111.Type de sol et localisation sur la topo séquence ?
112.Type de rotation ?
113.Itinéraire technique :

Opérations culturales	Date	intrants	Qté intrant	Coût intrant	Matériel utilisé	Tps de travail Total	MO Fam.	MO Ext.	prix de la MO Ext./jour

114.Production et utilisation :

Plante	Quantité totale produite	Quantité autoconsommée	Quantité vendue	Prix de vente	Acheteur

Note : Si l'étalement des ventes est important et forte variation saisonnière, faire un tableau.

115. Coût de transport ?

116.Evolution des rendements sur 10 ans ? Evolution de la fertilité du sol ?
117.Evolution de la pression des adventices ?

Manioc

118.Surface
119.Variété cultivée ?
120.Type de sol et localisation sur la topo séquence ?
121.Raison du choix de la culture ?
122.Précédent cultural ?
123.Appartenance à un type de rotation culturale ?
124.Cultures associées ?
125.Itinéraire technique :

Opérations culturales	Date	intrants	Qté intrant	Coût intrant	Matériel utilisé	Tps de travail total	MO Fam.	MO Ext.	prix de la MO Ext./jour

Note : penser à la coupe et au séchage

126. Rendement ?
127. Quantité autoconsommée ?
128. Quantité vendue ?
129. Prix de vente ? A quel moment de l'année la vente a-t-elle lieu ? Variation de prix de vente ?
130. Coût de transport ?

131. Evolution des rendements sur 10 ans ? Evolution de la fertilité du sol ?
132. Evolution de la pression des adventices ?

Systèmes de culture SCV

133. Accès à la parcelle ?
134. Surface
135. Type de sol et localisation sur la topo séquence ? histoire par année de SCV
136. Type de rotation ?
137. Itinéraire technique :

Opérations culturales	**Date**	**intrants**	**Qté intrant**	**Coût intrant**	**Matériel utilisé**	**Tps de travail total**	**MO Fam.**	**MO Ext.**	**prix de la MO Ext./jour**

138. Production et utilisation :

Plante	**Quantité totale produite**	**Quantité autoconsommée**	**Quantité vendue**	**Prix de vente**	**Acheteur**

Note : Si l'étalement des ventes est important et forte variation saisonnière, faire un tableau.

139. Coût de transport ?

140. Evolution des rendements sur 10 ans ? Evolution de la fertilité du sol ?
141. Evolution de la pression des adventices ?
142. Avantage des systèmes SCV
143. Inconvénients des systèmes SCV

Autres systèmes de culture annuelle

144. Surface
145. Type de sol et localisation sur la topo séquence ?
146. Variété cultivée ?
147. Précédent cultural ?
148. Appartenance à un type de rotation culturale ? Préciser.
149. Cultures associées ?
150. Itinéraire technique :

Opérations Culturales	Date	intrants	Qté intrant	Coût intrant	Matériel utilisé	Tps de travail total	MO Fam.	MO Ext.	prix de la MO Ext./jour

151. Rendement ?
152. Quantité autoconsommée ?
153. Quantité vendue ?
154. Prix de vente ? A quel moment de l'année la vente a-t-elle lieu ?
155. Coût de transport ?
156. Evolution des rendements sur 10 ans ? Evolution de la fertilité du sol ?

cultures maraichères

157. Surface
158. Type de sol et localisation sur la topo séquence ?
159. Variété cultivée ?
160. Précédent cultural ?
161. Appartenance à un type de rotation culturale ? Préciser.
162. Cultures associées ?
163. Itinéraire technique :

Opérations culturales	Date	intrants	Qté intrant	Coût intrant	Matériel utilisé	Tps de travail total	MO Fam.	MO Ext.	prix de la MO Ext./jour

164. Rendement ?
165. Quantité autoconsommée ?
166. Quantité vendue ?
167. Prix de vente ? A quel moment de l'année la vente a-t-elle lieu ?
168. Coût de transport ?
169. Evolution des rendements sur 10 ans ? Evolution de la fertilité du sol ?

Les Systèmes d'élevage

170. Mode de conduite : calendrier fourrager, mortalité, etc.
171. Dans un tableau : Animal, Race, Nombre de mâles et de femelles, Nombre de naissances, Mode de tenure, Autoconsommation, Prix de vente et période de vente, Quantité achetée, Prix d'achat, etc.
172. Calendrier de travail
173. Destination de la production ?
174. Utilisation des animaux comme force de travail?
175. Fréquence des ventes ?

Autres source de revenu agricole (net)

(Palmier à sucre, Pisciculture, Autres)

176. **Quelle est sa principale source de revenu agricole ?**

Revenus non agricoles

177. Aides de la famille extérieure (jeunes partis travailler à Phnom Penh ou expatiés) ?
178. Retraite ?
179. Activité ou responsabilité rémunérée dans le village ?
180. Location de terrain ?
181. **Activités off-farm** :
    - Produit au niveau de la ferme : artisanat, pêche, chasse, cueillette et temps de travaux correspondant
    - Activité de type commercial : commerce, transport, atelier de transformation (vin de riz par exemple) et temps de travaux correspondant
    - Ouvrier temporaire (agricole ou non) et nombre total de journées ouvrées par an

182. Marge nette annuelle
183. Revenu annuel (soit le revenu total des journées de travail off-farm)
184. Salaire journalier

185. **Quelle est sa principale source de revenu ?**

Autres

186. Recettes exceptionnelles (remboursement d'un prêt par exemple)
187. Moyens de transport (charrette, vélo…)
188. Existence de problèmes de trésorerie, si oui : date, objet et montant
189. **Principales dépenses du ménage :**

Estimation annuelle de l'alimentation (riz et autre)
L'éducation
La santé
L'habillement
Divers (mariages)

190. Estimation de la capacité d'autofinancement annuel (montant dégagé pour l'investissement)
191. A-t-il investit ou épargné (apporter des détails)
192. Autres charges de structure
193. Dépenses exceptionnelles (liées à la santé, etc.)
194. **Principales contraintes ? Principaux problèmes ?**
195. **Quelle culture est la plus intéressante (pénibilité, risque, opportunité…)? Pourquoi ?**
196. **Quelle culture rapporte le plus ?**
197. **Projets futurs, plans, souhaits, (investissements…)**

PROBLEMS IN CAPS SYSTEMS

What are the major problems you encountered in your crop production systems? Please rank them according to importance.

Problems	**1st cropping (Wet Season- 2010)** (Indicate Rank)	**2nd Cropping (Dry Season 2010)** (Indicate Rank)
a.		
b.		
c.		
d.		
e.		

Annex 4.4: Technology Networks and Gendered Knowledge Questionnaire Components for the SANREM baseline survey

Identification of the quality of relations within the agricultural production network

For both resource questions and the location and events question, only record the first response or primary interaction. If no resource or information (none) is accessed through interaction with a particular individual, go to the next individual.

People with which contact is made in order to conduct agricultural production activities (if no agricultural interaction, leave row blank)	What physical resources are accessed through interaction?	What form of information is accessed through interaction?	Who Initiates the contact most of the time?	Location and Events: Where do you interact?	Frequency: How often do you interact?	Quality: Can you trust resources/info from this source?	Gender
	1. Seed 2. Fertilizer 3. Pesticide 4. Herbicide/ weedicide 5. Tractor 6. Other_____ 7. None	1. Advice or consultation 2. Only information 3. None	1. Always them 2. Mostly them 3. 50/50 4. Mostly respondent 5. Always respondent	1. Farm 2. Store 3. Office 4. Market 5. NGO Office 6. Community center 7. Farmer field day/event 8. Home garden 9. Collective garden 10. Other_____	1. Weekly 2. Biweekly 3. Monthly 4. Seasonally 5. Yearly	1. Always 2. Most of the time 3. Somewhat 4. Rarely 5. Never	1. All male 2. Mostly male 3. 50/50 4. Mostly female 5. All female
Village chief							
Family member							
Neighbor/friend							
Vendor in weekly market							
Vendor in a shop in urban center							
Vendor in a agrochemical shop							
Teacher in village							
Minister/Priest/Imam in village							
Extension agent							

People with which contact is made in order to conduct agricultural production activities (if no agricultural interaction, leave row blank)	What physical resources are accessed through interaction?	What form of information is accessed through interaction?	Who Initiates the contact most of the time?	Location and Events: Where do you interact?	Frequency: How often do you interact?	Quality: Can you trust resources/info from this source?	Gender
	1. Seed 2. Fertilizer 3. Pesticide 4. Herbicide/ weedicide 5. Tractor 6. Other_____ 7. None	1. Advice or consultation 2. Only information 3. None	1. Always them 2. Mostly them 3. 50/50 4. Mostly respondent 5. Always respondent	1. Farm 2. Store 3. Office 4. Market 5. NGO Office 6. Community center 7. Farmer field day/event 8. Home garden 9. Collective garden 10. Other_____	1. Weekly 2. Biweekly 3. Monthly 4. Seasonally 5. Yearly	1. Always 2. Most of the time 3. Somewhat 4. Rarely 5. Never	1. All male 2. Mostly male 3. 50/50 4. Mostly female 5. All female
NGO Agent							
Agricultural researcher							
Development project agent							
Tractor owner							
Leader of farmer organizations							
Leader of women's organization							
Leader of youth organisation							
District assemblyman or his agent							
Other to be determined on site…(from focus group or key informant sources)							

2. Knowledge, beliefs and perceptions concerning agricultural practices

(check the cell that most closely applies for each belief).

Beliefs concerning agricultural practices	Strongly agree - 5	Agree - 4	Uncertain/neutral - 3	Disagree - 2	Strongly disagree - 1
Land is one‘s heritage to be preserved for future generations					
Farm labor should be replaced by more efficient herbicides and machines					
Engaging in multiple productive activities is always better than doing just one					
Farm income should always be reinvested to grow the business					
One should maintain a permanent crop cover					
It is better to grow staples within the household or community than purchase them.					
Applying chemical pesticides is always necessary					
Farm production is necessary to feed the family					
Inorganic fertilizer is best to improve soil quality					
Spreading crops and inputs across multiple plots is always necessary					
Planting decisions are always based off of current market prices					
Timely weeding (before setting of seed) is important to a successful harvest					
Crops should only be grown for sale					
Crop residues should only be fed to livestock and poultry					
Tillage causes land degradation					
One should always strive to grow the most on one‘s land					
The staple crop should be planted on the majority of the land *every* growing season					
Rotating crops is always best practice					
Land preparation for crop production begins with plowing.					
Earning off-farm income is more important than a large harvest					

Beliefs concerning agricultural practices	Strongly agree - 5	Agree - 4	Uncertain/neutral - 3	Disagree - 2	Strongly disagree - 1
Land preparation with crop production begins with plowing					

Perceptions of soil quality.

What are the most important criteria for evaluating soil quality? Next to each of the following criteria put a "3" for the most important; a "2" for the second most important; and a "1" for the third.

_____ water retention capacity

_____ the colour of the soil

_____ the quality of the crop it produces

_____ the quantity of organic material in the soil

_____ the quality of the soil when crumbled between one's fingers

_____ the quantity of the crop it produces

_____ the taste of the soil

_____ the effort needed to work the soil

Annex 5

Examples of annual cropping systems as defined in Olympe for 3 farmers
Value is given in x 1000 Riels.

gross margin per type of cropping system and margin per hour

Annual crops IN k RIELS

Agriculteur HOUTVOUTH

sesame kenlom

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
sesame 5200	Cereals	kg	5.20	700	3640
total Products					3640
external labor 3	External Labor	item	12.00	52	624
OIL	MACHINERY COSTS	L	3.50	10	35
total Expenses					659
Margin per unit					**2981**
Needs		hour		520	
Margin/hour		**Kriels**			**5.73**

Agriculteur HOUTVOUTH

SESAME HOURVOUTH

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
sesame 3600	Cereals	kg	3.60	75	270
total Products					270
hersage	services	item	100	1	100
Cyperan	insecticide	L	13.00	2	26
PLOUGHING 1	services	item	130	1	130
PLOUGHING 2	services	item	130	1	130
total Expenses					386
Margin per unit					**-116**
Needs		hour		176	
Margin/hour		**Kriels**			**-0.66**

Agriculteur HOUTVOUTH

RED CORN KENLOM

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
red corn 600	Cereals	kg	0.60	4000	2400
total Products					2400
external labor 3	External Labor	item	12.00	24	288
151515	Fertilizers	kg	2.60	1	3
zyco	herbicide	L	14.00	2.2	31
OIL	MACHINERY COSTS	L	3.50	10	35
BIDON KENLOM	herbicide	L	14.00 /1000L	3	0
total Expenses					356
Margin per unit					**2044**
Needs		hour		291	
Margin/hour		**Kriels**			**7.02**

Agriculteur HOUTVOUTH

RED CORN HOUTVOUTH

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
red corn 830	Cereals	kg	0.82	3300	2706
total Products					2706
PLOUGHING 1	services	item	130	1	130
PLOUGHING 2	services	item	130	1	130
hersage	services	item	100	1	100
sub total					360
external labor 2.5	External Labor	item	10.00	25	250
151515	Fertilizers	kg	2.60	1	3
zyco	herbicide	L	14.00	2	28
total Expenses					641
Margin per unit					**2065**
Needs		hour		176	
Margin/hour		**Kriels**			**11.74**

Agriculteur HOUTVOUTH

red corn sen mouna

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
red corn 600	Cereals	kg	0.60	4000	2400
total Products					2400
external labor 3	External Labor	item	12.00	20	240
Cyperan	insecticide	L	13.00	2	26
foliar fertilizer	Fertilizers	L	6.50	2	13
external labour service 27 000	External Labor	item	27.00	6	162
total Expenses					441
Margin per unit					**1959**
Needs		hour		880	
Margin/hour		**Kriels**			**2.23**

Agriculteur HOUTVOUTH

MUNGBEAN HOURVOUTH

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
mungbean	Proteaginous plants	kg	2.50	800	2000
total Products					2000
PLOUGHING 1	services	item	130	1	130
PLOUGHING 2	services	item	130	1	130
hersage	services	item	100	1	100
sub total					360
external labor 2.5	External Labor	item	10.00	70	700
Cyperan	insecticide	L	13.00	1	13
foliar fertilizer	Fertilizers	L	6.50	2	13
total Expenses					1086
Margin per unit					**914**
Needs		hour		328	
Margin/hour		**Kriels**			**2.79**

HOUTVOUTH

Agriculteur

mungbean sen mouna

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
mungbean	Proteaginous plants	kg	2.50	416	1040
total Products					1040
external labour_servive					
21000	External Labor	item	21.00	6	126
total Expenses					126
Margin per unit					**914**

Agriculteur HOUTVOUTH **treecrops** **Per tree**

tengen

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
tengen	Fruits	kg	4.00	40	160
total Products					160
Margin per unit					**160**
Needs		hour		24	
Margin/hour		**Kriels**			**6.67**

Agriculteur HOUTVOUTH **treecrops** **Per tree**

mango

NAME	CATEGORY	Unit	Prix Kriels	Quantity	Value
mango	Fruits	kg	1.50	30	45
total Products					45
Margin per unit					**45**
Needs		hour		16	
Margin/hour		**Kriels**			**2.81**

Synthetic table

sesame kenlom **Margin per unit** **Margin/hour**		 **Kriels**	 **2 981** **5.73**
SESAME HOURVOUTH Margin per unit Margin/hour		 Kriels	 -116 -0.66
RED CORN KENLOM Margin per unit Margin/hour		 Kriels	 2 044 7.02
RED CORN HOUTVOUTH Margin per unit Margin/hour		 Kriels	 2 065 11.74
red corn sen mouna Margin per unit Margin/hour		 Kriels	 1 959 2.23
MUNGBEAN HOURVOUTH Margin per unit Margin/hour		 Kriels	 914 2.79
mungbean sen mouna Margin per unit			 914
Tengen Margin per unit Margin/hour		 Kriels	 160 6.67
Mango Margin per unit Margin/hour		 Kriels	 45 2.81

Ca cropping systems according to PADAC recommandations

Agriculteur HOUTVOUTH

CA RED CORN PADAC HIGH YEARS

	Average	1	2	3	4	5	6	7	8	9	10 ...
Products	4 305	3 150	3 500	4 550	4 550	4 550	4 550	4 550	4 550	4 550	4 550
Expenses	1 309	1 336	1 256	1 312	1 312	1 312	1 312	1 312	1 312	1 312	1 312
Expenses Volume	0										
Margin	2 996	1 814	2 244	3 238	3 238	3 238	3 238	3 238	3 238	3 238	3 238
								20		26	
Total Margin		1 814	4 058	7 296	10 534	13 772	17 010	248	23 486	724	29 962
Margin/hour		7.31	9.05	13.06	13.06	13.06	13.06	13.06	13.06	13.06	13.06

Agriculteur HOUTVOUTH

CA RED CORN PADAC LOW YEARS

	Average	1	2	3	4	5	6	7	8	9	10 ...
Products	3 059	2 590	2 800	3 150	3 150	3 150	3 150	3 150	3 150	3 150	3 150
Expenses	1 309	1 336	1 256	1 312	1 312	1 312	1 312	1 312	1 312	1 312	1 312
Expenses Volume	0										
Margin	1 750	1 254	1 544	1 838	1 838	1 838	1 838	1 838	1 838	1 838	1 838
								11		15	
Total Margin		1 254	2 798	4 636	6 474	8 312	10 150	988	13 826	664	17 502
Margin/hour		5.06	6.23	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41

Agriculteur HOUTVOUTH

CA RED CORN PADAC MEDIUM YEARS

	Average	1	2	3	4	5	6	7	8	9	10 ...
Products	3 514	2 590	2 800	3 150	3 500	3 850	3 850	3 850	3 850	3 850	3 850
Expenses	1 309	1 336	1 256	1 312	1 312	1 312	1 312	1 312	1 312	1 312	1 312
Expenses Volume	0										
Margin	2 205	1 254	1 544	1 838	2 188	2 538	2 538	2 538	2 538	2 538	2 538
								14		19	
Total Margin		1 254	2 798	4 636	6 824	9 362	11 900	438	16 976	514	22 052
Margin/hour		5.06	6.23	7.41	8.82	10.23	10.23	10.23	10.23	10.23	10.23

Agriculteur HOUTVOUTH

RED CORN TRADI YEARS

	Average	1	2	3	4	5	6	7	8	9	10 ...
Products	2 254	2 800	2 660	2 520	2 450	2 310	2 170	2 100	1 960	1 820	1 750
Expenses	484	484	484	484	484	484	484	484	484	484	484
Expenses Volume	0										
Margin	1 770	2 316	2 176	2 036	1 966	1 826	1 686	1 616	1 476	1 336	1 266
								13		16	
Total Margin		2 316	4 492	6 528	8 495	10 321	12 007	623	15 099	435	17 702
Margin/hour		7.96	7.48	7	6.76	6.28	5.79	5.55	5.07	4.59	4.35

Annex 6

Soils and land use in the 2 selected villages

(Source B Ricard and C Chhoeum**, 2010)**

Boribo village

Most of the interviewed described the soils according to this classification:

Soils		Description / localisation	Proportions	Comments
Black soil (BS)		1. The color is black 2. After a rain, it is sticking, you can't walk ≠ SSS on which you can walk after a rain 3. From the main road to the hills 4. On BS, you can do rice but is rare 5. Are there land where you cannot grow maize for the second cycle? Yes, on black soil lower, but it is rare, a minority: maybe 20% of the surfaces => you can do rice on it instead of maize. You can gain money on this, but less than with Maize. 6. Only Black soils in Boribo.	70%	During dry season you can cultivate on BS, not on SSS (banana and sesame can die, ex: sesame this year no flower => cut it off) Fertility: BS > SSS
	Black soil high (BSh)	Closed to hill Very fertile (5-6 MT/ha (for red maize))		
	Black soil low (BSl)	At the centre of the village Quite fertile (Maize: 1 – 1.5 MT/ha) Can be over-flood	5% => rice	Rice depends on water retention capacity Not good for peanuts
Sandy soils (SS)		The Sandy soils are from another village: Kork chor and Sangha		Some interviewed said there are not SS (chief of the village), some said not
Sandy silk soils (SSS)		*Dey lbay ksach (DLK)*: *ibay* = lime, *ksach* = sand	30% 2% => rice	From the canal up to the Sangkha village 20m lower than BS >SSS: good in raining season (RS)
Red soils (RS)		There are closed to the hils, rare here		Some interviewed said there are not RS (chief of the village), some said not

An intermediary of Boribo (MR. MAO) gave another description which is closed to this one:

- Land of uplands (high): Red soil closed to the hills + Black soils
- Land of lower land: can do rice on it. But doesn't give good results bc a lot of weeds

Conclusion:

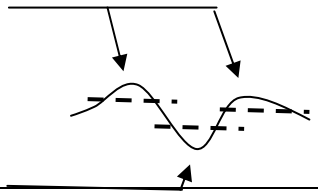
- Black soils seems to be the main soils of the village of Boribo
- Black soils in the higher parts are the most fertile soils, but in the lower parts there are some problems of over flooding, which can be an asset if you plan to do rice.
- The rate of clay and the water retention capacity depends on the localisation: the lower parts receive more water and have more clay.
    - The rice is possible on some black soils and some sandy silk soils on the lower parts

- The proportion is not clear: between 5% (BS) + 2% (SSS) = 7% and 20% according to another person (but information got at the end of a long interview)!
- Even with low yields (1-1.5 MT/ha), the gain is not to be denied

=> If the agriculture conservation techniques can improve the rice systems, the farmers could be interested

- The weed problem is quoted on lower lands, making the valorisation of the rice difficult.

Pich Changva village

Soils	Description / localisation	Proportions	Comments
Black soil (BS)	1. BS and RS are at the same level, always higher than SSS 2. BS are more fertile than SSS bc you can sow in dry season (water remaining in the soil) 3. Often pebbles on BS (on 30-40 cm) => can't grow orange trees 4. Mainly BS in Pich Changva	80%	1. for Chamcar, orchards; 2. Sometimes for rice 3. In some Black soil, not possible to do maize (very low yields bc too much water)
Sandy soils (SS)	No SS here (in another village beside PCV= Boum Chour)		Cannot do maize on it
Sandy silk soils (SSS)	2 kinds: • *Dey sra tchoum rew* = "soil rice deep": meaning deep water, a lot of water • *Dey sra deu* = "soil rice few water": meaning less water. The lowest = BS, SSS 	20%	You can do rice on those soils: • *Dey sra tchoum rew:* rice from Jun to Dec = late variety • *Dey sra deu*: rice from Jun to Nov = middle variety
Red soils (RS)	1. Less dark than the ones of KC 2. No red soil in Pich Changva		

Land use

CHIMM Chouet told us that:

1. Land for rice = 160 ha
2. Land for Chamcar = 600 ha
3. Land of Forest = 20-30 ha

The chief of the village gave us this estimation:

1. Land for rice = 250 ha (SSS)
2. Land for Chamcar = 800 ha
3. Forest = 100 ha
4. Total land = 1150 ha